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A MONOGRAPHIC STUDY OF THELYPODIUM AND ITS IMMEDIATE ALLIES¹

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INTRODUCTION

The present study was made with at least two objects in view; it was desired to continue investigations on the phylogeny of the *Cruciferae* and at the same time to attack a problem that would yield results of practical taxonomic value. These two objects, although distinct in their purpose, were of course very closely associated throughout the work. The taxonomy is but the expression of the phylogenetic conclusions. Recent studies in this family have emphasized the necessity of detailed examination of the various generic units before any general developmental theory is possible. The present author holds that there is no basis for a study of phylogeny equal to a taxonomic review of the species and genera involved. Details of specific distinction are most important in illustrating the steps in progressive differentiation. The present view held is that phylogenetic theories that do not take into account the apparently trivial details of specific characterizations are not dependable, since they are subject to too many sources of error. In the study of evolution the taxonomist's part is to lay down the broader lines of interspecific and generic change and point the direction of the current of progress. Where he leaves off, the work of the geneti-

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cist begins. The one study is incomplete without the other. With these two objects in mind, that is, phylogeny and taxonomy, no more promising field was seen than the group of genera here presented. Recent students of the *Cruciferae* have almost unanimously considered these genera among the most primitive in the family, and therefore it was thought that here phylogenetic studies would yield the most significant results. It was further realized that in no other group of American *Cruciferae* was the synonymy so involved due to the many interpretations of generic limits and the consequent segregation of genera and multiplication of nomenclatorial combinations. Furthermore, the species themselves are rather polymorphic and seem to lack convenient and easily definable differences. Here was a group that needed revision greatly in order to confirm or reject changes recently proposed. Since to *Thelypodium* were referred the largest number of species in this group it was taken as a reference point, and the related genera were investigated as the work progressed.

The study here reported was carried on at the Missouri Botanical Garden whose splendid library and herbarium were at the author's disposal at all times. For these privileges he is deeply indebted to the Director, Dr. George T. Moore. Assistance, encouragement and helpful criticism were given without stint by Dr. J. M. Greenman. To him especially is the author under great obligations. Herbarium specimens were borrowed from the Rocky Mountain Herbarium at the University of Wyoming, the Herbarium of the University of California, the Gray Herbarium, the United States National Herbarium, and the herbaria of Prof. Ellsworth Bethel and Mr. I. W. Clokey of Denver, Colorado. To these institutions and individuals the author wishes to express his gratitude. Much assistance in many ways was also rendered by the author's wife.

I. PHYLOGENY AND GENERAL MORPHOLOGY THELYPODIUM

This genus, as limited in the following taxonomic treatment, contains but a small number of the species that have at one time or another been referred to it. The following remarks, of course, concern only the species recognized by the writer as belonging to the genus in this limited sense. *Thelypodium* thus restricted becomes a homogeneous group of limited geographical distribution and is presumably of monophyletic origin. It is the purpose

of these remarks to demonstrate the general characteristics of the common ancestor, the phylogenetic sequence of characters, and to correlate these findings with the geographical distribution of the various units.

The gynophore.—*Thelypodium* received its name because of a gynophore or stipe that in many species raises the ovary and fruit above the torus. Of the fourteen species in the genus, seven are found to possess a distinct stipe and in the others the ovary is not quite sessile. Five species of the seven show a stipe that at least occasionally reaches a length of two millimeters. It is most highly developed in *T. laciniatum* and *T. eucosum*, being usually more than two millimeters long. What is the significance of this stipe?

Recent students of the *Cruciferae* are nearly unanimous in the belief that this family has been derived from the *Capparidaceae* or from capparidaceous-like ancestors. In this connection it is sufficient to refer to the writings of Hallier,¹ Lotsy,² von Hayek,³ and Engler and Gilg.⁴ In the *Capparidaceae* a stipe is almost universally present and is often very long. Granting this relationship between the two families, the presence of a stipe in the *Cruciferae*, in which it is not of common occurrence, must be considered either a primitive character or an atavistic variation. For the sake of argument and as a point of attack the stipe in this group will be assumed to be a primitive characteristic. The question now arises: Are the two species that possess the longest stipe primitive in other respects?

The pods.—In many genera of the *Cruciferae* the capsules or pods are known to display characters of the utmost importance taxonomically. This is not true of *Thelypodium* to such an extreme degree, except as regards the cellular structure of the septum. The capsules are often particularly variable in length. They are usually terete, glabrous, and many times longer than wide. Frequently the valves are somewhat constricted between the seeds and the pod becomes torulose in consequence. In two species, *T. laciniatum* and *T. affine*, the valves are slightly compressed parallel to the septum. It has been found impossible to attach much phylogenetic importance to this character within

¹Hallier, H. Provisional scheme of the natural (phylogenetic) system of flowering plants. *New Phytol.* 4:157. 1905.

²Lotsy, J. P. *Vorträge über botanische Stammesgeschichte* 3:915-916. 1911.

³von Hayek. *Entwurf eines Cruciferen-Systems auf phylogenetischer Grundlage.* *Beih. Bot. Centralbl.* 27¹: 176-178. 1911.

⁴Engler, A. und Gilg, E. *Syllabus der Pflanzenfamilien*, 8th ed., 201. 1919.

the genus, and it has evidently appeared separately in the two species mentioned since they are not closely related. In *Caulanthus* it would seem that flattened pods have been derived from terete ones, and there appears to be no reason to imagine a different sequence in *Thelypodium*.

Although the length of the pods is not of great value in specific determination, the average length is of considerable interest. The longest pods are found in *T. laciniatum* and its varieties. These range in length from about three centimeters to at least twelve. Other species with long pods are *T. sagittatum*, *T. eucosum*, *T. stenopetalum*, *T. Howellii*, and *T. vernale*. The identity of the last is in doubt, and since it may not belong in this genus it scarcely deserves mention. Reduction in the number of seeds has been found in another genus of this family (*Lesquerella*) to be correlated with divergence from the ancestral type, and this might be supposed to apply also to *Thelypodium*. Decrease in the length of the pods is a crude measure of reduction in the number of ovules. To consider long pods primitive and short ones derived is at least in keeping with what would be expected from previous studies. It will be remembered that *T. eucosum* and *T. laciniatum* were the two species with the longest stipes—it is significant that in these species long pods occur.

Style and stigma.—In all the species of *Thelypodium* the style is short and the stigma small and scarcely, if at all, lobed. No characters of taxonomic or phylogenetic importance have been observed here.

Septum.—The cellular pattern of the septum in this genus is very characteristic. Extending nearly or quite from end to end of the pod through the middle of the septum there is a broad region composed of cells elongated parallel to the marginal framework. This region covers from about one-fourth to one-half of the surface of the septum and there the cell-walls are more or less closely compacted. In some species this dense band is yellowish and then it becomes conspicuous even under a hand lens. Such a condition is noticed in *T. integrifolium* and its immediate allies, in *T. flexuosum*, and to a lesser degree in *T. crispum*. The two marginal bands that occur on either side of the dense middle region often differ in different species. The cells in this area are always short and may be more or less rectangular with somewhat tortuous walls or may be irregular and elongated at right angles to the margin. But little use has been

made of differences in the septum to distinguish the species, but as a generic character the pattern is of great importance. No species are now admitted to *Thelypodium* that do not exhibit this type of septum. There are, however, species outside the genus that have apparently developed a similar type independently.

It would be difficult to trace any developmental series in the character of the septum, but it is of some interest to notice that in *T. laciniatum*, which has been found primitive in at least two respects, the cell-walls in the middle region are not so closely compacted as in certain other species. The septum of *T. eucosum* is not known.

Seeds.—As far as present studies show, the seeds in this genus are very uniform and furnish no characters of taxonomic or phylogenetic importance. In common with related genera the position of the radicle in the species of *Thelypodium* is almost invariably oblique with reference to the cotyledons. Occasionally the seeds are slightly pointed or apiculate but are never winged or conspicuously margined.

The flowers.—In common with most of the members of this family the flowers of *Thelypodium* do not exhibit much variation. Only two points need be considered here, the shape of the petals and their color. In shape they vary from narrowly linear, as in *T. stenopetalum*, to broadly oblanceolate, as in *T. flexuosum*. Since neither of these species is primitive as to length of stipe or pod it seems probable that neither of these two extremes represents the ancestral type for the genus. Rather we would be inclined to suppose a broadly linear or long-spatulate form more nearly like the original, since it occurs in *T. laciniatum*, *T. eucosum*, and certain other species that seem primitive in other respects. Within the genus the petals are never conspicuously crisped or channeled as in *Caulanthus*; they are always entire and there is rarely any differentiation between blade and claw.

In color the petals of the various species range from red-purple to blue and white. No species with yellow petals is known. *T. laciniatum* has white petals, and *T. eucosum* has red-purple ones. Within specific limits the range in color is often extreme, as in *T. lilacinum* in which the petals vary from deep purple to white. There is indication, however, that the color forms are more or less isolated geographically and therefore the variation may have its phylogenetic significance. The form of that species that occurs in the eastern part of its range seems to be almost entirely white.

There are some reasons for suspecting that the original color of the flowers of this genus were purple and that this color gave rise to white. The best evidence to be obtained on this question, however, comes from an examination of related genera and will be considered in another paragraph. This much may be said from a study of *Thelypodium* alone: there is no reason to doubt such an hypothesis even though there is little to confirm it.

Inflorescence.—The characters of the inflorescence have been utilized to considerable extent in specific delimitation. As in most *Cruciferae* the flowers in this genus are borne in a raceme and are not subtended by bracts or leaves. Two different types are recognized in *Thelypodium*. The first is characterized in the key and descriptions as "racemose." By this is understood that type exhibited by *T. brachycarpum* or *T. Howellii* for example. In these species and some others the flowers when they open are some distance below the apex of the cluster. In *T. brachycarpum* the raceme is dense and in *T. Howellii* lax. This distinction obtains between other species. The second condition is described as "corymbose." It is illustrated by *T. sagittatum* and *T. flexuosum*. In those species the flowers when they open are near the apex of the inflorescence and form a somewhat flat-topped cluster. In both the racemose and corymbose types the inflorescence when mature is elongated and truly racemose. In the key and descriptions "inflorescence" means the flower cluster—by "mature inflorescence" is meant the arrangement of the pods upon the axis.

There are also several good taxonomic characters to be obtained from a study of the pedicels. The position is either horizontal or ascending, and there is little variation between individuals of a given category in this respect. Some species are well characterized by very short pedicels, others have slender ones which may or may not be slightly flattened at the base.

For several reasons it has been thought that the primitive inflorescence was elongated even before anthesis, that it was probably rather dense, and that the pedicels were short and stout, perhaps angled and probably horizontal. Such a condition may be observed in *T. eucosum*, *T. laciniatum* and its variety *strep-tanthoides*, *T. brachycarpum*, and others. This type seems to predominate in those species that may be considered primitive in other respects. It is also significant that in *Stanleya*, a closely related genus and one that is more primitive than *Thelypodium* in many respects, the inflorescence is universally dense and the pedicels are horizontal.

Leaves.—The species of *Thelypodium* may be grouped in three divisions according to the shape of the stem-leaves. In nine species they are entire and amplexicaul at the base. In *T. laciniatum* and its varieties they are irregularly toothed or lobed and more or less petioled. In the remaining four species the leaves are entire but not auriculate at the base. Within the genus there is in all the known species a differentiation between cauline and radical leaves. The radical leaves are generally oblanceolate in outline and entire or subentire. In only four species are they conspicuously toothed, namely, *T. brachycarpum*, *T. crispum*, *T. Howellii*, and *T. laciniatum*. In many species a definite petiole is present.

Among those species having entire amplexicaul stem-leaves the most primitive in respect to the length of the stipe, the type of inflorescence, and the form and color of the petals is undoubtedly *T. eucosum*; the most specialized in these and other characters is *T. flexuosum*. In the former the basal lobes are well developed, in the latter they are more reduced than in any other species of this group. From *T. eucosum* the other species with amplexicaul stem-leaves may be derived without difficulty. Among the species having entire but not amplexicaul stem-leaves it would be hard to say which is the most primitive. That there is no great gap between this group and the first is shown by the fact that in *T. lilacinum* (and probably in others) small auricles are sometimes present at the base of the leaves. It seems more probable that this type of leaf was derived by the reduction of the basal lobes than that the change was in the other direction. It remains now to consider the third type of leaf—the lobed and petioled stem-leaves of *T. laciniatum*. Unlike *T. eucosum*, *T. laciniatum* has no near relatives. It seems to represent an ancient offshoot from primitive stock rather than to be the ancestor of species now extant. It may have been derived from a species with amplexicaul leaves but there is no reason to suppose that it has given rise to species with that type of leaf, since they can be traced to a different ancestry. The entire amplexicaul stem-leaf is considered the earlier type and from it the others are believed to have been derived. In *Lesquerella* it was shown that those species having this type of stem-leaf were primitive; it is not surprising to find the same order of development obtaining in another genus of the same family.

Because of comparative uniformity in the differentiated radical leaves in this genus there is little evidence relating to the steps

in this differentiation between radical and cauline leaves. Have these basal leaves been developed from amplexicaul stem-leaves or has the change been in the other direction? Judging by analogy with *Caulanthus*, in which genus the problem does not seem particularly difficult, it is supposed that the original radical leaf was entire and amplexicaul and that it has given rise to the petioled, lobed leaf independently from time to time. There seems to be a constant tendency for entire leaves to become lyrate-lobed or pinnatifid within the *Cruciferae* in general, although an advance into xerophytic conditions seems frequently to be accompanied by the reverse order.

Trichomes.—Nine species of *Thelypodium* are entirely glabrous and the other five vary from glabrous or nearly glabrous to quite densely pilose near the base. The trichomes are usually long and always unicellular and unbranched. No specific specialization of trichome structure has been noticed in this genus. The plants are ordinarily more or less glaucous as well as glabrous.

Those two species, *T. eucosum* and *T. laciniatum*, which have been considered primitive are glabrous, and because of lack of evidence to the contrary it is assumed that the glabrous condition gave rise to the pubescent one. The change is apparently not a difficult one since in the same species glabrous and pubescent individuals occur. It is of interest to note that the trichomes when they are present, appear only near the base of the plant. This correlates in a significant way with the theory of the origin of radical from stem-leaves as will be discussed under *Caulanthus*.

Duration.—All but three species of this genus are evidently biennial, and of these three two are usually biennial but may persist for several years, as *T. sagittatum* and *T. ovalifolium*. One only is definitely perennial as may be seen from the numerous remains of former leaf-bases that clothe the caudex in *T. flexuosum*. A definite assumption of the perennial habit doubtless represents a specialized condition. With this perennial habit is closely correlated the differentiation between stem and radical leaves in which the latter form a definite rosette. The otherwise more primitive species of the genus are biennial, and the perennial or partially perennial species are the more specialized ones. It is therefore assumed that the biennial preceded the perennial habit in *Thelypodium*.

The generic limits of Thelypodium.—As stated elsewhere, many species have been referred to this genus that are not now

included in it. No attempt will be made in the present paper to place all these species generically. All that now may be said as to many of them is that they may not be included in *Thelypodium*. This does not mean that the various segregate genera recently proposed by Dr. P. A. Rydberg will necessarily be maintained by the present author—it does mean that their affinities are not with this genus.

Pleurophragma.—This group was proposed as a genus by Dr. Rydberg to include *Thelypodium integrifolium* and its immediate allies and was based primarily on the presence of a "strong and broad midrib of the septum of the pod." It was also stated that "there is no distinct midvein in any of the typical *Thelypodia*." Another character that might be used to support *Pleurophragma* is found in the leaves. They are here sessile, entire, and not amplexicaul—a combination that obtains in no species of *Thelypodium* except in this group. That this character, while useful in a key, is of no very great phylogenetic significance, is shown by the occasional appearance of auriculate lobes at the base of the leaves in individuals of *T. lilacinum*. In these exceptional cases the leaves are not unlike those of the amplexicaul group. The value of the "strong and broad midrib of the septum" is scarcely of more importance. The cellular pattern of the septum has already been discussed, and it has been shown that in all the species of *Thelypodium* there is a differentiated middle region where the cells are elongated parallel to the replum and the cell-walls more or less closely compacted. No other "pattern" occurs in the species transferred to *Pleurophragma* although here the extreme in differentiation is probably reached. The "strong and broad midrib" results from the fact that in these species the dense middle zone is colored yellow and so stands out in contrast to the marginal cells. Furthermore, this differential coloring of the middle region is not peculiar to *T. integrifolium* and its allies. It is also seen in *T. flexuosum* and in individuals at least of *T. crispum*. From a morphological viewpoint it would seem impossible to retain *Pleurophragma* as distinct from *Thelypodium*.

The phylogenetic relationships of the species of "*Pleurophragma*" among themselves are not clear. This is due in part to the slight differentiation between the species and in part to the evidence offered by *T. rhomboideum* var. *gracilipes*. Two hypotheses seem possible: first, it might be supposed that the group originated in western Colorado or Utah and that *T. rhomboideum*

var. *gracilipes* is the most primitive form since it possesses the longest stipe. On this theory *T. rhomboideum* would be derived from it and have given rise to *T. lilacinum*, *T. integrifolium*, and *T. affine*. From what is known of the frequently limited distribution of primitive species in other genera, the restricted range of the variety *gracilipes* would seem to argue that it is a primitive form. If this theory is accepted it is necessary to suppose that the group in question was derived from some wide-ranging primitive species of *Thelypodium* that is now extinct.

The second hypothesis as to the origin of "*Pleurophragma*" is that the species developed from the same plexus as did *Thelypodium* proper. *Thelypodium rhomboideum* may be thought of as the most primitive form. It gave rise to *T. integrifolium* on the north and to *T. affine* on the south. One specimen has been seen from western Colorado (Goodding 1789) that seems intermediate between *T. rhomboideum* and *T. lilacinum*. In this region, probably, *T. lilacinum* was developed from the other species. The variety *gracilipes* with its long stipe would, according to the second hypothesis, be considered an atavistic variation of *T. rhomboideum*. It is then not necessary to imagine an extinct, wide-ranging species of *Thelypodium* to account for the long distance of the variety *gracilipes* from the plexus of *Thelypodium* proper. Except for the stipe the variety *gracilipes* is not more primitive than *T. rhomboideum*. The present author favors the second theory as being the more probable. In either case "*Pleurophragma*" could scarcely be considered worthy of generic rank, but under the first hypothesis it has somewhat greater phylogenetic justification.

Thelypodiopsis.—Perhaps the most perplexing of the segregate genera is "*Thelypodiopsis*." The species transferred here are very similar in appearance to *Thelypodium sagittatum* and at a casual glance some are likely to be confused with it. There are, however, certain technical differences that should not be overlooked. Most important of all is the septum. It is here a uniform membrane quite different from that of *Thelypodium* with its differentiated middle band. The stigma in "*Thelypodiopsis*" is usually distinctly lobed with the lobes extended over the placenta; in *Thelypodium* it is ordinarily quite entire or rarely may show a tendency for the lobes to be extended over the valves. From a phylogenetic viewpoint the two groups are well differentiated. "*Thelypodiopsis*" seems to have had its origin in northern Arizona and the species have spread both north and

south from there. The plant that is supposed to represent the most ancient type of "*Thelypodopsis*" is *Thelypodium ambiguum* Wats. It is not here transferred to the segregate genus because the author does not yet wish to recognize "*Thelypodopsis*" as worthy of generic rank. *Thelypodium ambiguum* must be associated with "*Thelypodopsis*" *elegans* (Jones) Rydb. and

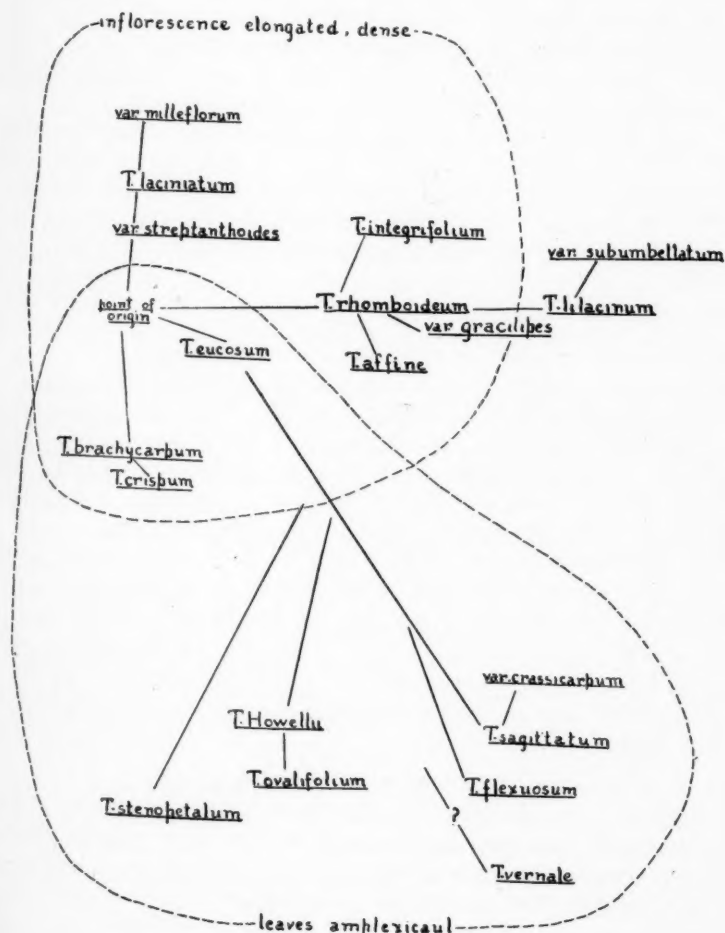


Fig. 1. Phylogenetic chart of the species of *Thelypodium*.

"*T.*" *aureum* (Eastwood) Rydb. wherever they may be placed eventually. The limits of "*Thelypodopsis*" are not yet determined.¹

GEOGRAPHICAL DISTRIBUTION

The genus *Thelypodium* as limited in the present paper has a comparatively restricted distribution. The species are mostly confined to the region between the Cascade or Sierra Nevada Mountains of extreme western North America and the Rocky Mountains of Montana, Wyoming, and Colorado. No species are known from Canada or from Mexico. One doubtful plant, *T. vernale*, occurs in New Mexico. *Thelypodium stenopetalum* is found in the San Bernardino Mountains of southern California: the most southern point known for the genus. Two species with their varieties are found in the Rocky Mountains and have crossed the Continental Divide in several places. *Thelypodium lilacinum* reaches western Nebraska and this marks the easternmost known extension of *Thelypodium*. The genus is richest in species in eastern Oregon.

Thelypodium may be supposed to have originated in or not far from the eastern Oregon region. Several reasons may be advanced to support this conclusion: (1) The greatest specific concentration occurs in this region. (2) Those species held previously to be the most primitive occur here. (3) Conversely, those species farthest from this region show in general those characters considered to be of most recent development. (4) In this region also occurs a genus with more primitive characters than *Thelypodium* from which *Thelypodium* may have arisen. This genus is *Stanleya*. (5) From here is known that species of *Stanleya* which is annual, has amplexicaul stem-leaves, and no differentiated basal rosette—characters common in *Thelypodium* but rare in *Stanleya*. This species is *Stanleya confertiflora* (Robinson) Howell.

In general the members of *Thelypodium* prefer a rather strongly saline soil that at one season of the year at least is wet. Consequently they are usually found on bottom lands rather than on rocky hillsides. No species have become adapted to an alpine habitat.

¹Species of this group and related forms have been recently treated as species of *Sisymbrium* by the author in Univ. Wyo. Publ. Bot. 1: 1-27. 1922.

SUMMARY OF CONCLUSIONS ON THELYPODIUM

1. A long stipe or gynophore that raises the ovary or pod above the torus is believed to be a primitive character.
2. Similarly, a long, terete pod is considered more primitive than a short or compressed one.
3. The cellular pattern of the septum is thought to be very important as a generic character but is found to show few specific differences.
4. The ancestral species of this genus are supposed to have had broadly linear or long-spatulate petals that were probably reddish in color.
5. The dense, racemose inflorescence is held to be primitive and from it have probably been derived the lax, racemose, and the corymbose types.
6. The pedicels are thought to have been horizontal in the primitive species. They were also, perhaps, rather stout.
7. The leaves of the ancestral species were probably entire and amplexicaul.
8. Trichomes are not present in the more primitive species of the genus, and their appearance is held to be a sign of specialization.
9. The biennial habit of growth is more primitive than the perennial, but it was probably derived from the annual at no very remote period.
10. This genus is believed to have originated in eastern Oregon or not far from there.
11. *Thelypodium* probably arose from *Stanleya* or some *Stanleya*-like species.
12. Those species formerly included in *Thelypodium* but recently segregated under the name *Thelypodiodopsis* are not referable to *Thelypodium*.
13. The segregate genus *Pleurophragma* is not considered worthy of generic rank and its species are referred to *Thelypodium*.

CHLOROCRAMBE

The genus *Chlorocrambe* is maintained by the present writer chiefly because of the doubtful phylogenetic position that may be assigned to its single species. When first discovered this plant was placed in *Caulanthus* by Dr. Watson without question as to the propriety of such a disposition of it. Dr. Rydberg, when he raised *C. hastata* to generic rank, named three charac-

ters by which this species was different from species of *Caulanthus*. The calyx in *Caulanthus* was described as urn-shaped and more or less closed, while in *Chlorocrambe* it is open; the petals of *Caulanthus* were thought to be of the type seen in *C. crassicaulis*, narrow, channeled, crisped and recurved, while in *Chlorocrambe* they are flat, dentate, and have short claws; the stigma of *Caulanthus* was described as conspicuous and two-cleft, while in *Chlorocrambe* it is entire and small. These characters do serve to distinguish it from such species of *Caulanthus* as *C. crassicaulis*, *C. major*, *C. glaucus*, and *C. pilosus*. These are the species nearest to it geographically. If *Caulanthus* is accepted in the larger sense, however, these characters alone are not sufficient to warrant its generic segregation. In *Caulanthus anceps*, for example, the sepals are spreading and the calyx not at all urn-shaped; in *C. lasiophyllus*, *C. Cooperi*, and *C. anceps* the petals are flat and the proportions of the claw and the blade not essentially different; in *C. amplexicaulis* the stigma is quite entire. There are two characters at least possessed by *C. hastata* that are not admitted to *Caulanthus*—the toothed petals and the definite stipe.

In spite of its several points of agreement with species of *Caulanthus* and its habitual resemblance to certain species, the evidence at hand goes to show that this plant has more probably been derived from *Thelypodium* or some immediate ancestor of that group than from *Caulanthus*. The evidence for this conclusion may be summarized as follows: first, the presence of a stipe is unknown in *Caulanthus* but is of common occurrence in *Thelypodium*; second, the inflorescence is more suggestive of the primitive species of *Thelypodium* or even of *Stanleya* than of any species of *Caulanthus*; third, its geographical position argues for its relationship to *Thelypodium* rather than to *Caulanthus*; finally, the entire stigma is common to all species of *Thelypodium* but is found only in the primitive species of *Caulanthus*, with which *C. hastata* does not agree in other respects. Only a few collections of *C. hastata* are known but it would appear that those individuals from Oregon possess a longer stipe than do those from Utah. If this prove to be true it would indicate that the Oregon form is the more primitive. Since it is in this region that the primitive species of *Thelypodium* occur this would argue for a common origin.

The question now arises as to the advisability of transferring this species to *Thelypodium* rather than keeping it up as a mono-

typic genus. The plant in question differs from all species of *Thelypodium* in the toothed petals and in the uniform septum. It has evidently given rise to no species now included in *Thelypodium* nor has it been derived from any species now extant. If it were placed in *Thelypodium* it would introduce an anomalous element into an otherwise homogeneous group. All things considered then, it seems best to retain *Chlorocrambe* as a unit distinct from either *Thelypodium* or *Caulanthus* but probably more closely related to the former than to the latter.

CAULANTHUS

The gynophore.—A slender stipe of one millimeter or more is not known in any species of *Caulanthus*. In some species, however, the pods are not quite sessile upon the torus. This short stipe, if such it may be called, is always thick and never comparable to that found in many species of *Thelypodium*. There is obviously but one conclusion to be drawn from this: if the long stipe is held to be a primitive character, then as a genus, *Caulanthus* is not so primitive as *Thelypodium*.

The pods.—In *Thelypodium* it was pointed out that those species which possessed long pods had preceded those with short pods in the sequence of development. An analysis of the length of the pods in *Caulanthus* shows a high degree of intra-specific variation and only in a very general way may the species be compared on this character. Because of the occurrence of long pods in species otherwise primitive and not because of any *a priori* argument it is believed that in *Caulanthus*, as in *Thelypodium*, long pods have preceded short ones in point of time.

With two exceptions the pods of this genus are practically terete. In *C. heterophyllus* they are somewhat compressed or quadrangular and in *C. californicus* the valves are slightly keeled. These species are evidently not closely related to one another nor may any developmental series be made by considering them primitive. They are obviously recent and more or less aberrant members of the genus.

Style and stigma.—In the majority of the species the style is very short and surmounted by a large stigma. The length of the style seems not to be constant for the species. One group of species, however, is characterized, in part, by the possession of a style that tapers appreciably from base to apex. This type has been described as "conic" in the key. This character reaches

its highest development in *C. lasiophyllus*, but even here it is trivial and serves rather for confirmation of relationship than as a definite diagnostic character. The small stigmas that terminate the styles of this type serve to emphasize this character.

The degree of lobing of the stigma is of considerable diagnostic value. Except in those species with conic styles, in which it is uniformly and minutely two-lobed, the stigma varies from entire to deeply two-lobed. In these species the lobing is invariably such that the lobes are produced over the valves. The lobes are always much more evident in the mature fruit than in the flower. This is perhaps due to the collapse of parenchymous tissue on drying and the consequent emphasizing of the vascular strands of the style. In the descriptions the length of the lobes of the stigma is derived from measurements in the fruit. It is believed that the entire stigma represents the primitive type and the degree of lobing is a measure of specialization. In *Thelypodium*, which is to be considered more primitive than *Caulanthus*, the stigma is almost universally entire. Those species of *Caulanthus* that are evidently aberrant and specialized—as *C. heterophyllus* and *C. californicus*—exhibit a definitely lobed stigma.

Septum.—The cell pattern of the septum in *Caulanthus* is quite uniform except for two or three species. It is thin and of short, mostly straight-walled cells of nearly equal breadth and length. This is in striking contrast to that of *Thelypodium* in which there is a highly differentiated middle band. The exceptions referred to occur in *C. anceps* and *C. lasiophyllus*. In the first species the cells are not unlike the normal type for the genus except that the walls are somewhat tortuous rather than straight. In the second the walls are tortuous and the middle region is differentiated as in *Thelypodium*. If one were to judge from the septum alone *C. lasiophyllus* would have to be retained in *Thelypodium* where it has previously been carried.

Seeds.—Few characters of taxonomic value are found in the seeds. In most of the species they are neither winged nor margined, and usually the cotyledons are somewhat oblique with respect to the radicle. This is the condition found in *Thelypodium* exactly. The relative position of the cotyledons and radicle is often quite variable. In *C. pilosus*, for instance, the position may vary greatly in seeds of the same individual. The most conspicuous exceptions to the usual structure are seen in *C. hetero-*

phyllus in which the seeds are narrowly winged and in *C. californicus* in which the cotyledons are deeply trifid.

The flowers.—The flower parts in *Caulanthus* offer more points of taxonomic and phylogenetic interest than they do for most of the genera of this family. The sepals may be nearly equal as in the majority of the species, or one pair may be definitely longer than the other, as in *C. Coulteri*. In many species they are more or less saccate, this character reaching its extreme in *C. californicus*. Species are now admitted to this genus with reduced, nearly flat sepals, and in one species, *C. anceps*, they are distinctly spreading.

The petals are equally diverse. In the great majority of the species they are narrow and crisped, with little differentiation between blade and claw. Petals of this type are usually channeled and curved outwards at the apex. In the past this type of petal was considered a generic character of *Caulanthus*, and species that did not show it were not included within the genus. In the present work, however, it has seemed impossible to exclude species with petals having plane blades and short claws.

In color the sepals and petals vary from purple to yellow, or the petals may be green in some species or individuals. An interesting change in color is noticed in the sepals of *C. Coulteri*, *C. Lemmonii*, and *C. californicus* as development proceeds. In the bud these organs are a deep purple but as the flower develops the color becomes paler until in the old blossom the purple color is scarcely evident.

The stamens of *C. inflatus*, *C. Coulteri*, *C. Lemmonii*, and *C. californicus* are of particular interest because of the frequent tendency of the two pairs of longer stamens to be more or less united by the filaments. This character serves not only to confirm the generic unity of *C. californicus* with *Coulteri* but furnishes evidence that the four long stamens have developed from two by multiplication of the anthers and filaments. The present cases would be considered partial reversions to an ancestral condition.

The phylogenetic sequence of the different types of floral structure becomes evident only by a correlation of these characters with the characters of the leaves, trichomes, pods, etc. Since the most primitive species possess a closed and slightly saccate calyx and narrow, crisped and channeled petals, it has been assumed that these types are primitive and that from them the other types have been evolved. It would seem that the flat,

oblanceolate type of petal has been developed four times within the genus, since it is found in *C. sulfureus*, *C. Cooperi*, *C. anceps*, and *C. lasiophyllus*. With the exception of the last two, these species are not closely related. The primitive color may have been purple.

Inflorescence.—The flower cluster in species of *Caulanthus* is, almost without exception, a lax raceme. The most interesting and significant detail of the inflorescence is to be found in the mature pedicels. In *C. Cooperi*, *C. simulans*, *C. heterophyllus*, and *C. stenocarpus* the pedicels are recurved and the pods deflexed. In *C. Coulteri*, *C. californicus*, *C. anceps*, and *C. lasiophyllus* the pedicels are either recurved or curved upwards and the pods in consequence are either deflexed or erect. With these species must be associated *C. Lemmonii* and *C. flavescens*. So far as is known the pods of these are always erect. This group of ten species is evidently closely related, to judge from other points of similarity, and is partially characterized by a tendency to develop recurved pedicels and deflexed pods. This character presents a strong argument for the retention of these ten species within one genus.

Leaves.—In ten species the cauline leaves are conspicuously amplexicaul by auriculate basal lobes. In eight they are either sessile or, usually, distinctly petioled; in neither case are the basal lobes developed. Three or four species have leaves that are nearly or quite entire. The leaves of the other fourteen or fifteen species are, in part at least, definitely toothed. In *Caulanthus* no such definite differentiation between radical and cauline leaves occurs as in *Thelypodium* but in most species the leaves near the base of the stem are usually longer, narrower, and more distinctly toothed than the upper stem-leaves. Since these basal leaves are often more closely crowded upon the stem than are the upper ones, there is an approximation to the rosette habit.

The inter-specific leaf variation seems to offer the best guide to the phylogenetic development within the genus. To judge from findings in *Thelypodium* the amplexicaul leaf would be considered primitive. Since this is the more usual form it is easier to examine those species with petioled than with clasping leaves. These are *C. glaucus*, *C. pilosus*, *C. Hallii*, *C. major*, *C. crassicaulis*, *C. flavescens*, *C. anceps*, and *C. lasiophyllus*. Five of these are species in which trichomes are developed. Two of the glabrous species, *C. major* and *C. crassicaulis*, are perennials. The first five species, and this includes the third glabrous

one, have definitely two-lobed stigmas. It will be recalled that the presence of trichomes, the assumption of the perennial habit, and the two-lobed stigmas are considered recent characters in this genus and in *Thelypodium*. It would seem then that the group of species with petioled stem-leaves is not primitive. This conclusion is strengthened by the evident fact that these eight species are not closely related forms but represent at least three different lines of development. They are interpreted as being at the ends of the several lines of evolution, and so it seems certain that the petioled leaf has been developed independently at least three times within the genus *Caulanthus*.

The transition between stem- and basal-leaves that occurs in some species of *Caulanthus* has already been referred to several times. In such a species as *C. heterophyllus*, for instance, may be seen a gradual transition from entire, amplexicaul upper stem-leaves to toothed, elongated, and non-clasping basal-leaves. This transition is believed to show the way in which the differentiation has occurred and to show that the basal-leaves have originated from the stem-leaves. It is significant that in the more primitive species, such as *C. amplexicaulis*, *C. inflatus*, and *C. Cooperi*, no differentiation is evident. It is also of interest to note that whenever trichomes are present they occur only at the base of the plant or are most numerous there. This basal region seems, therefore, in some way to retain fewer of the ancestral characters and to be the first to assume recent modifications.

Duration of life.—The species of *Caulanthus* are mostly annual. Two species only, *C. major* and *C. crassicaulis*, are short-lived perennials, although some of the annual species may approach the biennial habit. There seems to be, however, no true assumption of the biennial habit as in *Thelypodium*. Since the two perennial species may not be considered primitive for other reasons it is supposed that the annual condition is the more primitive.

GENERIC LIMITS OF CAULANTHUS

Caulanthus, as here treated, contains many more species than have been referred to it formerly and consequently embraces a greater range of morphological variation. These changes have made a formerly homogeneous group somewhat heterogeneous and have involved a number of nomenclatorial transfers. These two results are, in some ways, unfortunate but are inevitable if the present theory of development is correct and if classification

is to follow phylogenetic lines. The question of the generic disposition of the various species is, of course, a question of phylogeny.

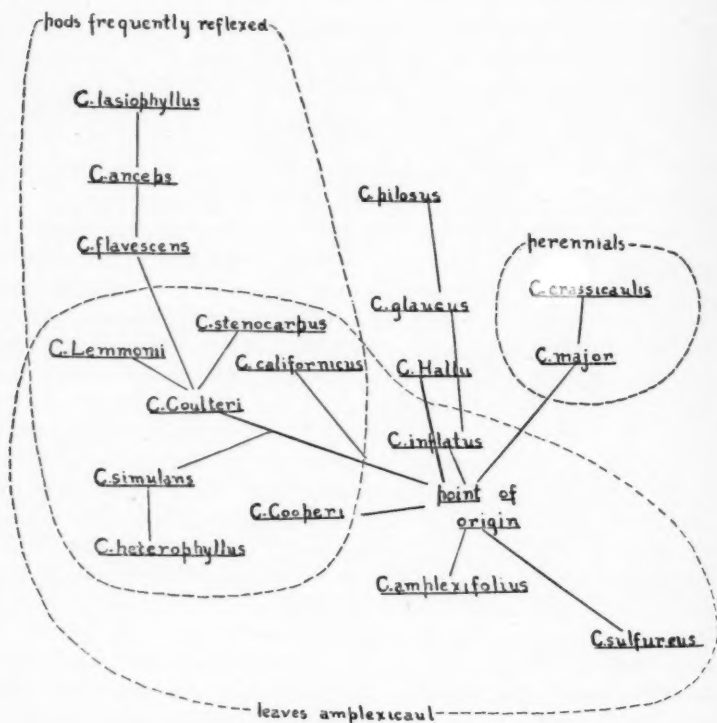


Fig. 2. Phylogenetic chart of the species of *Caulanthus*.

Guillenia.—Most interesting, in the light of the present generic limits of *Caulanthus*, is a consideration of those species designated by Dr. Greene as constituting a new genus—*Guillenia*. *Caulanthus lasiophyllus* was designated as the type of that genus, and with it and two of its varieties were associated *C. flavescens*, *C. Cooperi*, and *Streptanthella longirostris*. As will be seen by an examination of the phylogenetic chart of *Caulanthus* that accompanies this paper, *Guillenia* is a monophyletic group. Dr. Greene here united a group of closely related forms as a unit distinct from *Thelypodium*. *Guillenia* cannot be maintained under a broader generic concept and so becomes a part of the larger

group—*Caulanthus*. An exception must be made in the case of *Streptanthella longirostris* (*Guillenia rostrata* of Greene). Although probably derived from this group of species, it seems better to retain it as a separate genus than to transfer it to *Caulanthus*.

It is perhaps most difficult to appreciate the true generic position of *C. lasiophyllus*. If it were included in *Thelypodium* it would have to be associated with *T. laciniatum* on account of the form of the leaves since it does not resemble, even remotely, any other species. *T. laciniatum* is one of the most primitive species in the genus. If *lasiophyllus* were admitted to *Thelypodium* it would be considered one of the most highly specialized in several ways. The sessile pods, the corymbose inflorescence, and the numerous trichomes are recent characters. To have a highly specialized species developed from a very primitive one would be somewhat surprising since there would be no known intermediates. The annual habit of *lasiophyllus* does not accord with the usual biennial habit of *Thelypodium*. The recurved pedicels are also an aberrant character. From *Caulanthus* in the old, restricted sense, *C. lasiophyllus* is equally aberrant. If, however, the genus is enlarged to include *C. anceps* and *C. flavescens*, *C. lasiophyllus* does not seem out of place. *Caulanthus flavescens* has been known in *Caulanthus* for many years (as *C. procerus*) and has not been considered aberrant there. If this is admitted the inclusion of *lasiophyllus* is logical. Intermediate between *lasiophyllus* and *flavescens* is *C. anceps*. The three are evidently related and the differences are slight. *C. lasiophyllus* has a septum similar to that in *Thelypodium* but it has evidently been developed independently.

Stanfordia.—As pointed out elsewhere it is considered best to unite this monotypic genus with that group to which it is very certainly related. The single distinctive character it possesses (the trifid cotyledons) is not thought to be of sufficient importance to warrant its generic independence.

GEOGRAPHICAL DISTRIBUTION

Caulanthus is slightly more restricted in its distribution than is *Thelypodium*. Its species occur in the arid parts of western North America and chiefly between the Mexican boundary and the northern limits of California, Nevada, and Utah. One species, *C. lasiophyllus*, is known to occur in peninsular California

and has been reported also from as far north as Washington and as far east as Colorado. This species is the most widely distributed of the genus and has apparently spread as a weed along lines of transportation. Except for this species no members of the genus are known from Colorado.

Evidence at hand goes to show that *Caulanthus* originated in the interior region of southern California. Several reasons may be given for this belief: (1) In this region occurs the greatest number of species. (2) The most primitive species of the genus occur here. (3) The species at the greatest distance from this point are the most recent species phylogenetically.

SUMMARY OF CONCLUSIONS ON CAULANTHUS

1. Probably long, terete pods are to be considered primitive in *Caulanthus* and the shorter or compressed ones as derived.
2. The entire stigma is considered primitive and the degree of lobing is thought to be indicative of the degree of specialization. The most deeply lobed stigmas are found in those species that are most specialized in other respects. In *C. lasiophyllus* and its allies, however, this rule does not hold, since in this group the stigma is quite uniform and but slightly lobed.
3. The "cell pattern" of the septum is found to be of great importance as a generic character in *Caulanthus*. In *C. lasiophyllus* a type similar to that seen in *Thelypodium* is believed to have been independently developed.
4. The narrow, crisped and channeled type of petal is considered primitive for this genus. The flowers of the ancestral species were probably purple in color.
5. The most primitive type of inflorescence found in *Caulanthus* is lax and racemose.
6. Amplexicaul cauline leaves are believed to represent the primitive type and from them the petioled basal- or stem-leaves have been developed.
7. The presence of trichomes is an indication of specialization. They were probably not present in the first species of *Caulanthus*.
8. *Guillenina* of Greene could be maintained as a genus without offense to phylogeny but it is found inadvisable to separate it from *Caulanthus*.
9. The annual habit is held to be primitive.
10. *Stanfordia* of Watson is not thought worthy of generic rank and is merged with *Caulanthus*.

11. *Caulanthus* is believed to have originated in the interior region of southern California.

STREPTANTHELLA

The single, rather uniform species that constitutes this genus is an annual herb of comparatively wide distribution in the arid parts of western North America between the Sierra Nevada or coast ranges of California, Oregon, and Washington and the Rocky Mountains of Wyoming, Colorado, and New Mexico. It penetrates into the desert region of northwestern Mexico on the south but does not reach the Canadian boundary on the north. The species seems never to have crossed the Rocky Mountains.

The affinities of this plant have long been in doubt. As a member of *Arabis* it was evidently out of place. In *Streptanthus* it was somewhat less anomalous but was obviously not closely related to any known species of that genus. Dr. Greene seems to have been the first to associate it with its nearest relatives when he included it in *Guillenia*. It appears not to be very closely related to those species, however, and in the present treatment is not included with them in *Caulanthus*. The recurved pedicels give the strongest evidence of this relationship of *Streptanthella* to the *Guillenia* group of *Caulanthus*. The narrow, more or less crisped petals and the southwestern distribution of *S. longirostris* strengthen the argument that this species has been derived from the same stock as *C. Cooperi* and *C. lasiophyllus*. If this connection is not recognized then it must be admitted that no point of attachment is known between this species and other *Cruciferae*. If this relationship is accepted the question arises as to the advisability of uniting *Streptanthella* with *Caulanthus* rather than maintaining it as a distinct genus.

Streptanthella has been maintained for several reasons. In the first place the relationship between it and *Caulanthus* can not be considered as proved. In the second place it is believed that the divergence from species of *Caulanthus* is sufficient to warrant generic segregation. The attenuation of the valves of the pod into a beak that simulates a style is a character unknown among the species of *Caulanthus*. The resulting type of dehiscence is peculiar. The valves, when dry, become free and curve away from the base but remain attached at the apex. The pods are more definitely compressed than in any species of *Caulanthus*. Since *Streptanthella* is thus not considered to be descended from those species of *Caulanthus* with flattened pods this character

must have been independently developed. The septum of *S. longirostris* is unlike that of any species of *Caulanthus*. There is here a differentiation of the middle cells. Those near the margin are elongated at right angles to the replum and are not tortuous. These give way toward the middle to cells that are somewhat tortuous and finally elongated parallel to the margin. The narrowly winged seeds indicate a development parallel to the condition in *C. heterophyllus*.

WAREA AND STANLEYELLA

Warea is a very homogeneous group of four species that occurs in the extreme southeastern part of the United States. Here they seem to be confined to sandy habitats. Their remarkable isolation from related species has undoubtedly been a factor in their universal retention within a single genus, since morphologically they are rather similar to species of *Stanleya* or *Stanleyella*. In general appearance they resemble certain species of *Cappariaceae* more closely than they do any other species of *Cruciferae*. Indeed the first species of *Warea* to be described was described as a *Cleome*.

Most of the characters of the species of *Warea* have been considered primitive in other genera. They are all annuals with erect, branching stems. The leaves are all entire and in one species they are deeply amplexicaul. Trichomes are not known to occur on any of the species. The petals vary in color from white to red-purple. The pedicels are straight and horizontally spreading although the inflorescence is definitely corymbose and does not elongate greatly even in fruit. The fruit is definitely stipitate, linear, and divaricate-falcate. The stigma is subentire.

All four species possess one character that serves to distinguish them from all related genera and, so far as the author knows, from all other species of *Cruciferae*. The pedicels in *Warea* are deciduous from the main axis of the inflorescence and fall away attached to the mature pods. Since the line of abscission is not quite even with the surface of the rachis there remains a small base attached to the stem. The presence of these remnants after the inflorescence has become quite mature gives a characteristic roughened or knobbed appearance to the axis. The mechanism by which this abscission occurs has not been thoroughly studied but, from sections made of the dried

material, seems to be due to a simple breaking apart of the cells in a certain region.

The septum in *Warea* is somewhat similar to that seen in *Thelypodium*. There is a differentiation between the cells near the margin and those in the middle. The latter are somewhat tortuous and considerably elongated. The walls are not densely compacted as in some species of *Thelypodium*.

That species which may be considered most primitive on account of the amplexicaul leaves occurs in eastern Florida. It does not, however, possess the longest stipe, although there is no considerable difference between the various species in the length of that organ. It is scarcely possible to trace any developmental sequence between the species that may be correlated with geographical distribution. This is of course partly due to the limited variation between the species and to their restricted range. *Warea Carteri* may well be an offshoot from *W. cuneifolia*.

Stanleyella is evidently most closely related to *Warea* but may be considered distinct from that genus because of the persistent pedicels, the much shorter stipe, and the different septum. The septum in *Stanleyella* is somewhat differentiated between margin and middle, but the cells are not tortuous as in *Warea*. The leaves in *Stanleyella* are toothed, while in *Warea* they are entire. Trichomes are present in some individuals of *Stanleyella* but have not been noticed in *Warea*. *Stanleyella* may be restricted to the southwestern and *Warea* to the southeastern portions of the United States. *Stanleyella* is undoubtedly to be considered less primitive than *Warea*, but because the absciss mechanism in the pedicels is lacking it was probably developed from a common ancestor and not from any of the present species of *Warea*.

KEY TO THE GENERA

The genera treated in the present paper may be contrasted and their chief morphological characters summarized by the following key. This key, it must be understood, makes no attempt to account for genera that are closely related but have not yet been elaborated.

- A. Sepals spreading or reflexed in anthesis; glabrous or very sparsely pubescent, annual or biennial herbs; blade of petal entire; stigma entire or nearly so; pedicels slender, divaricate; pods widely spreading.
 - a. Stipes 5 mm. or more long; leaves entire; pedicels becoming detached from the rachis at maturity-----WAREA

- b. Stipes, if evident, not over 2 mm. long; leaves usually lobed; pedicels persistent -----STANLEYELLA
- B. Sepals erect or connivent, except in a few species; glabrous to conspicuously pubescent, annual, biennial or perennial herbs; blade of petals entire or toothed; stigma entire or 2-lobed; pedicels various; pods erect, divaricate or reflexed.
- a. Pods frequently stipitate; biennial or perennial herbs; petals flat, entire or toothed; pedicels never strongly recurved; stigmas entire.
- I. Petals entire, purple, white, or blue; septum differentiated in the middle; leaves, except in one species and its varieties, entire -----THELYPODIUM
- II. Petals toothed, white or greenish white; septum nearly uniform; leaves petioled and irregularly margined -----CHLOROCRAMBE
- b. Pods sessile or subsessile on a very broad stipe; annual or perennial herbs; petals entire, flat, or channeled and then usually crisped and narrow; pedicels various, frequently recurved; stigmas entire or 2-lobed.
- I. Valves of the pod separating from the replum at maturity, rarely strongly flattened; stigmas entire or 2-lobed; pedicels various -----CAULANTHUS
- II. Valves of the pod produced into a beak at the apex and at maturity separating from the replum only at the base, strongly flattened; stigmas entire; pedicels recurved -----STREPTANTHELLA

TAXONOMY

TAXONOMIC HISTORY OF THE SEVERAL GENERA

Thelypodium and *Stanleyella*.—The first species of *Thelypodium* to be described was *T. laciniatum*. W. J. Hooker studied this plant from material collected by Douglas and referred it to *Macropodium* in 1830. In 1838, Torrey and Gray recognized it as generically distinct from that genus and published the genus *Pachypodium* from Nuttall's manuscript. Besides *laciniatum* there were now referred to *Pachypodium* two other species, *integrifolium* and *sagittatum*. The choice of the name *Pachypodium* was an unfortunate one because of the previously published genus of the same name by Lindley (1830) in the *Apocynaceae* as well as the *Pachypodium* of Webb and Berthelot (1836-1840). This latter genus was based on a cruciferous plant now generally assigned to *Sisymbrium* (*S. erysimioides* Desf.). In 1839 Endlicher proposed the name *Thelypodium* to replace the untenable *Pachypodium* of Nuttall. This first publication gives only a description with a reference to the genus proposed by Nuttall which *Thelypodium* was to replace. In Walpers' 'Repertorium' (1842) the name *Thelypodium* was again taken up and to it were assigned three species—*T. laciniatum*, *T. integrifolium*,

and *T. sagittatum*. At this time, then, the name *Thelypodium* was definitely established to replace the unfortunate name of *Pachypodium* as used by Nuttall. The genus was, of course, considered distinct from *Macropodium*.

From 1842 until 1907 the number of species assigned to *Thelypodium* gradually increased. In 1852 Dr. Gray added the first anomalous element as *T. Wrightii*—now *Stanleyella Wrightii*. After this, *Thelypodium* became a receptacle for many plants which, on account of their entire stigmas, were not admitted to *Sisymbrium*. Dr. Watson transferred a number of species to *Thelypodium* which had originally been described as species of *Streptanthus* or *Sisymbrium*. In 1895 there appeared in the 'Synoptical Flora' an excellent treatment of *Thelypodium* in the larger sense by Dr. Robinson. In this treatment the diversity of the species retained is recognized and sections are proposed to contain the more different groups.

The first attempt at segregation was made in 1907 when Dr. Rydberg separated from this *Thelypodium* complex the new genera *Thelypodopsis*, *Pleurophragma*, *Hesperidanthus*, *Stanleyella*, and *Heterothrix*. In the present study *Pleurophragma* is again united to *Thelypodium*, and *Stanleyella* is recognized as a distinct genus. No disposition of the other segregates is made at the present time except that they are not to be retained in *Thelypodium*.

Caulanthus and *Chlorocrambe*.—Watson in 1871 proposed the genus *Caulanthus* to include five species of *Cruciferae* from western North America. Of these five, two were described as new and three were transferred from *Streptanthus*. The first species mentioned and the one on which the genus was evidently founded is *C. crassicaulis* (*Streptanthus crassicaulis*). This species not only agrees more closely with the generic description than do the others but in a note following the specific description this explanation of the new generic name is given: "known as 'Wild Cabbage', and sometimes used as a tolerable substitute for the cultivated plant. This fancied affinity to the Cauliflower-tribe of more favored regions has suggested the generic name." This species then would, without doubt, become the generic type if the group were segregated. Only one species of the five included in the original treatment of the genus is not now considered congeneric with the others, *C. hastatus*. Following the publication of *Caulanthus* a few species were added from time to time and the validity of the genus was almost universally accepted. As

in *Thelypodium* the most extended account of *Caulanthus* previously published was by Dr. Robinson in the 'Synoptical Flora.' In this work nine species were recognized. In the present treatment the author has found it necessary to transfer to *Caulanthus* several species carried for many years in other genera as well as to describe a few new species. Accordingly the number of species has been increased and the limits of intrageneric diversity greatly extended.

The only segregation of *Caulanthus* in its former limited sense that has ever been attempted was the removal by Dr. Rydberg in 1907 of *C. hastatus* as the type of the monotypic genus *Chlorocrambe*.

Streptanthella.—Dr. Rydberg in 1917 proposed this monotypic genus to contain a species of uncertain affinities. This plant was first described by Watson as *Arabis longirostris* in 1871 but in 1889 was transferred by the same author to *Streptanthus* and has been generally treated in that genus up to the present time. In 1906 Greene included this species in his genus *Guillenia* as *G. rostrata*.

Warea.—The similarity of species of this genus to certain caparidaceous plants was recognized by Muhlenberg who in 1813 proposed the name (without description) *Cleome cuneifolia* for the plant now known as *Warea cuneifolia*. However, it was soon recognized that its affinities were with the *Cruciferae* rather than with the *Capparidaceae*. DeCandolle in 1821 independently described *cuneifolia* as *Stanleya gracilis* and Nuttall in 1822 published *amplexifolia* as a *Stanleya*. It was in 1834 that Nuttall reconsidered this disposition of these plants and erected the genus *Warea*, named in honor of Nathaniel A. Ware, to receive them. Nuttall recognized but two species although it seems evident that he had three at hand, and that he based the genus primarily upon his earlier *Stanleya amplexifolia*. Since that time the validity of the genus has not been questioned and but two species have been added to it.

THELYPODIUM

THELYPODIUM Endl. Gen. 876. 1839; Walp. Rep. 1: 172. 1842; Wats. Bot. King's Exp. 25. 1871, in part; Brewer & Wats. Geol. Survey Calif. Bot. 1: 37. 1876, in part; Prantl in Engler & Prantl, Nat. Pflanzenfam. III. Abt. 2: 155. 1891; Robinson in Gray, Syn. Fl. N. Am. 1¹: 173. 1895, in part; Nelson in Coulter &

Nelson, Manual Cent. Rocky Mountains, 209. 1909, in part; Hayek, Beih. Bot. Centralbl. 27¹: 184. 1911; Rydb. Fl. Rocky Mountains, 366. 1917, in part.

Macropodium Hook. Bot. Misc. 1: 341. 1832, in part; Hook. Fl. Bor. Am. 1: 43. 1840, not R. Br.

Pachypodium Nutt. in Torr. & Gray, Fl. N. Am. 1: 96. 1838, not Webb & Berthel.; Benth. & Hook. f. Gen. Pl. 1: 81. 1862.

Pleurophragma Rydb. Bull. Torr. Bot. Club 34: 433. 1907; Wooton & Standley, Contr. U. S. Nat. Herb. 19: 267. 1915; Rydb. Fl. Rocky Mountains, 368. 1917.

Biennial or perennial herbs with differentiated radical and cauline leaves and usually erect, simple or branched stems. Trichomes absent or unbranched. Stem-leaves frequently sagittate at the base. Flowers purple, lilac, roseate or white; sepals scarcely if at all saccate; petals linear, oblong or oblanceolate, entire; anthers frequently apiculate. Inflorescence usually racemose, rarely corymbose. Pods terete or slightly flattened parallel to the partition, distinctly stipitate or sessile, 1.5–10 cm. long, 1–2 mm. wide, horizontal to erect; style short, stigma small, entire or very slightly 2-lobed. Cells of the septum elongated parallel to the replum in the middle, usually more or less tortuous, shorter, and walls usually less closely compacted near the margin; this central region of elongated cells frequently appears under a hand lens as a broad midvein. Seeds not winged, cotyledons usually obliquely incumbent. Generic type: *T. laciniatum* (Hook.) Endl.

KEY TO THE SPECIES

- A. Cauline leaves sagittate or amplexicaul at the base.
 - a. Stipe about 2 mm. long; flowers red-purple; inflorescence dense, racemose, pedicels horizontal ----- 1. *T. eucosum*
 - b. Stipe usually less than 2 mm. long.
 - I. Biennials or short-lived perennials.
 - *Raceme dense, narrow, spike-like; pedicels rarely over 5 mm. long.
 - 1. Pedicels stout, divergent, 1–2 mm. long ----- 2. *T. brachycarpum*
 - 2. Pedicels slender, erect, 3–5 mm. long 3. *T. crispum*
 - **Raceme lax and narrow or, if dense, corymbose and broader; pedicels usually more than 5 mm. long.
 - 1. Petals spatulate or broader.
 - 0. Inflorescence distinctly racemose.
 - x. Radical leaves lyrate toothed; plants native to Oregon and California --- 4. *T. Howellii*
 - y. Radical leaves entire; plants native to Utah, Arizona and New Mexico.

Probably biennial, glabrous throughout, more or less glaucous: radical leaves oblanceolate, narrowed to a petiole, subentire; cauline leaves oblong to lanceolate, entire, 2-6 cm. long, usually acute, amplexicaul at the base: sepals reddish purple, narrow, 6-7 mm. long, not saccate; petals narrowly spatulate, 8-11 mm. long, red-purple; filaments linear, 6-7 mm. long, purplish, anthers about 3 mm. long, apiculate: inflorescence racemose; pedicels horizontal or slightly descending, enlarged at the apex, 3-5 mm. long: pods arcuate, ascending, terete, slightly torulose, 3-4.5 cm. long (not mature); stipe about 2 mm. long; style less than 1 mm. long; stigma entire, small.

Distribution: eastern Oregon. Type: *Nevius* from Baker City.

Specimens examined:

Oregon: Blue Mountains, May 21, 1885, *Howell 345* (Gray Herb.); Baker City, 1875, *Nevius* (Gray Herb., TYPE).

A very beautiful and quite distinct species that has been collected but seldom. Because of its striking appearance this scarcity in herbaria must indicate a very limited range or infrequent occurrence.

2. *T. brachycarpum* Torr. U. S. Expl. Exp. 17: 231, *t. 1*. 1874; Wats. Bot. King's Exp. 26. 1871, in part; Brewer & Wats. Geol. Survey Calif. Bot. 1: 37. 1876, in part; Robinson in Gray, Syn. Fl. N. Am. 1st: 174. 1895, in part.

Biennial, glabrous or sparsely pilose towards the base: stems 3-15 dm. high, simple or virgately branched, usually stout: radical leaves oblanceolate or spatulate, definitely toothed to deeply lyrate-pinnatifid, 4-6 cm. long; cauline leaves 1-5 cm. long, narrow, acute, entire or toothed, sagittate at the base and sessile, basal lobes acute: sepals and petals white, the former linear-lanceolate, acute, the latter linear, 2-3 times as long as the sepals; stamens exserted, filaments nearly equal, anthers nearly 2 mm. long, distinctly sagittate at the base, apiculate: inflorescence dense, racemose; pedicels stout, 1-2 mm. long, divergent: pods unequally torulose, ascending, 15-30 mm. long; stipe 1-1.5 mm. long; style about 0.5 mm. long, stigma truncate, small; seeds not winged.

Distribution: southern Oregon and northern California. Type: *Wilkes' Expedition* "on the Klamet River, southern borders of Oregon."

Specimens examined:

California: near Yreka, Siskiyou County, June 11, 1876, *Greene 846* (Mo. Bot. Gard. Herb.); 6,300 ft. altitude, Scott's Mountain, Aug. 29, 1880, *Engelmann* (Mo. Bot. Gard. Herb.); north side of Mt. Shasta, June 15-30, 1897, *Brown 469* (Mo. Bot. Gard. Herb.); Shasta Valley, June, 1903, *Hall & Babcock 4092* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.); Montague, June 9, 1905, *Heller 8011* (Mo. Bot. Gard. Herb.); Shasta Valley, Aug. 21, 1910, *Butler 1850* (Univ. Calif. Herb.).

True *T. brachycarpum* is not so common a plant as formerly supposed. Most of the material that has previously been referred here is now assigned to *T. crispum*. The original drawing of this

species together with the station from which the type was obtained is sufficient to establish its identity.

3. *T. crispum* Greene, n. sp.¹

T. brachycarpum Gray, Proc. Am. Acad. 6: 520. 1866, not Torr.; Wats. Bot. King's Exp. 26. 1871, in part; Brewer & Wats. Geol. Survey Calif. Bot. 1: 37. 1876, in part; Greene, Fl. Franciscana, 262. 1891; Robinson in Gray, Syn. Fl. N. Am. 1¹: 174. 1895, in part.

Biennial, glabrous or sparingly pilose towards the base: stems 3–8 dm. high, simple or virgately branched: radical leaves oblanceolate or spatulate, nearly entire to deeply lyrate, 4–6 cm. long; cauline leaves 1–5 cm. long, linear-sagittate, acute, sessile, entire or shallowly repand, basal lobes acute: sepals and petals white (the former occasionally purple), the latter linear-spatulate, about twice as long as the sepals; stamens exserted, filaments nearly equal, anthers 2.5–3 mm. long, apiculate, sagittate at the base: inflorescence dense, racemose; pedicels slender, 3–5 mm. long, erect: pods unequally torulose, 1.5–3 cm. long; stipe about 1 mm. long; style 0.5–1 mm. long, stigma small, truncate.

Distribution: western Nevada and adjacent California.

Specimens examined:

Nevada: Lake Washoe, 1865, *Torrey 14* (Mo. Bot. Gard. Herb.); Empire City, June 19, 1882, *Jones 3769* (Mo. Bot. Gard. Herb. and Clokey Herb.); Washoe Lake, June 3, 1897, *Jones* (Mo. Bot. Gard. Herb.); Eagle Valley, Ormsby County, June 28, 1902, *Baker 1191* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb., TYPE); King's Canyon, Ormsby County, July 30–Aug. 1, 1902, *Baker 1218* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.).

California: 1875, *Lemmon* (Mo. Bot. Gard. Herb.); Dixey Valley, Lassen County, July 6, 1894, *Baker & Nutting* (Univ. Calif. Herb.); Milford, June 26, 1892, *Brandeggee* (Univ. Calif. Herb.); Sierra County, 1874, *Lemmon 12* (Mo. Bot. Gard. Herb.); Sierra County, 1875, *Lemmon 24* (Mo. Bot. Gard. Herb.); Sierra County, July, 1892, *Sonne 337* (Mo. Bot. Gard.

¹*Thelypodium crispum* Greene, sp. nov., bienn glabrum vel basi pilosum; caule 3–8 dm. alto simplice vel ramoso, ramis strictis; foliis radicalibus oblanceolatis subintegris vel lyratis 4–6 cm. longis; foliis caulinis 1–5 cm. longis lineari-sagittatis acutis sessilibus amplexicaulibus integris vel repandis; sepalis petalisque albis, petalis lineari-spatulatis, staminibus exsertis; inflorescentiis dense racemosis, pedicellis gracilibus erectis 3–5 mm. longis; siliquis torulosis erectis 1.5–3 cm. longis, stipite circiter 1 mm. longo, stylo 0.5–1 mm. longo, stigmate parvo integro. —Collected in Eagle Valley, Ormsby County, Nevada, June 28, 1902, *Baker 1191* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb., TYPE).

Herb.); Sierra County, July, 1894, *Sonne* (Univ. Calif. Herb.); Purdy, July 1, 1907, *Heller & Kennedy 8671* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.); McFarland's mill, Placer County, July 11, 1886, *Sonne* (Univ. Calif. Herb.); Mono Pass, 1866, *Bolander 6272* (Mo. Bot. Gard. Herb.); Bloody Canyon, Mono County, July 20, 1889, *Chestnut & Drew* (Univ. Calif. Herb.); meadows at Bishop, Inyo County, June 1, 1906, *Hall & Chandler 7284* (Univ. Calif. Herb.).

Herbarium specimens labelled "*T. crispum* Greene," a name that has apparently never been published, serve as the type of a new species definitely distinct from *T. brachycarpum* by the slender, erect pedicels.

4. *T. Howellii* Wats. Proc. Am. Acad. 21: 445. 1886; Robinson in Gray, Syn. Fl. N. Am. 1¹: 174. 1895; Howell, Fl. Northwest Am. 58. 1897; Frye & Rigg, Northwest Flora, 179. 1912.

Streptanthus Howellii Jones, Proc. Calif. Acad. II. 5: 623. 1895.

Thelypodium simplex Greene, Pittonia 4: 200. 1900.

Biennial, more or less hispid-pubescent near the base, otherwise glabrous, somewhat glaucous: stems slender, erect, simple or branched at the base, sparingly branched above, 3–8 dm. high: radical leaves rosulate, oblanceolate, obtuse, lyrate-toothed, 2–4 cm. long; cauline leaves entire, lance-linear, acute, erect and usually appressed, sagittate at the base, sessile, 1–4 cm. long: sepals usually purplish, lateral somewhat saccate at the base, scarious margined, about 7 mm. long; petals pale blue or purple, spatulate, crisped, twice as long as the sepals; stamens slightly longer than the sepals: inflorescence racemose, lax; pedicels ascending, about 5 mm. long, stout: pods erect or ascending, 2–5 cm. long, about 1 mm. wide; stipe less than 0.5 mm. long; style about 1 mm. long, stigma entire; septum uniformly colored.

Distribution: eastern Oregon and northeastern California. Type: *T. Howell* from "Camp Polk and in Harney Valley, eastern Oregon."

Specimens examined:

Washington: 1883, *Brandegee 638* (Univ. Calif. Herb.).

Oregon: Yanex Reservation, July, 1893, *Austin* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); wet soil, Farewell Bend, Crook County, July 16, 1894, *Leiberg 455* (Mo. Bot. Gard. Herb.); wet meadow, Camp Polk, June 14, 1902, *Cusick 2812*

(Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); moist, sub-alkaline soil of Silver Creek, Aug. 8, 1901, *Cusick 2735* (Univ. Calif. Herb., Mo. Bot. Gard. Herb., and Rky. Mt. Herb.); dry alkaline meadows, eastern Oregon, June, 1897, *Cusick 1618* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.).

California: Big Valley, Modoc County, June 29, 1894, *Baker & Nutting* (Univ. Calif. Herb.); adobe meadows, Dixey Valley, Lassen County, July 6, 1894, *Baker & Nutting* (Univ. Calif. Herb.).

5. *T. ovalifolium* Rydb. Bull. Torr. Bot. Club 30: 253. 1903; Rydb. Fl. Rocky Mountains, 367. 1917.

T. Palmeri Rydb. Bull. Torr. Bot. Club 34: 432. 1907; Rydb. Fl. Rocky Mountains, 367. 1917.

Biennial or short-lived perennial, glabrous or sparsely hirsute below: stems several from the base, rather slender, decumbent, simple or sparingly branched, 3-6 dm. high: radical leaves somewhat rosulate, outermost broadly oblanceolate, about 2 cm. long, later ones 5-7 cm. long, narrowly oblanceolate or with a broadly oval blade, abruptly narrowed to a slender petiole, petioles more or less ciliate; cauline leaves sagittate, erect, about 2 cm. long: sepals oblong, about 4 mm. long; petals spatulate, about 7 mm. long: inflorescence narrow, racemose, elongated and rather lax when mature; pedicels ascending, rather stout, 4-6 mm. long: pods ascending or erect, somewhat torulose, subsessile, 1.5-3 cm. long, 1 mm. wide; style 1-2 mm. long, stigma small, entire; septum similar to that of *T. sagittatum*.

Distribution: southern Utah. Type: *M. E. Jones 6015e* from Panguitch Lake.

Specimens examined:

Utah: Panguitch Lake, Sept. 7, 1894, *Jones 6015e* (U. S. Nat. Herb., TYPE); southern Utah, 1877, *Palmer 25* (Mo. Bot. Gard. Herb.).

Although insufficiently known, it seems evident on comparison of type material of *T. ovalifolium* and *T. Palmeri* that but one species is represented. In the former the pods are 1-2.5 cm. long and the basal leaves are nearly glabrous except for ciliations on the petioles; in the latter the pods are 1.5-3 cm. long and the basal leaves sparsely hirsute. Only two collections are known and these evidently came from localities not far separated since the type of *T. Palmeri* was from "southern Utah." The differences are so slight and the habitual resemblance is so great that these

plants must be considered conspecific, at least until further collections confirm their segregation.

6. *T. vernale* Wooton & Standley, Contr. U. S. Nat. Herb. 16: 128. 1913, and 19: 268. 1915.

Biennial, glabrous: stems slender, branched throughout, glaucous, purplish near the base, about 4 dm. high, the branches strongly ascending: cauline leaves triangular-lanceolate, attenuate, 3.5–5 cm. long, slightly glaucous, entire, somewhat undulate, auriculate-clasping at the base, the lobes obtuse, 5–7 mm. long: sepals narrowly oblong, obtuse, 2.5 mm. long, green or tinged with purple; petals white, slightly tinged with purple, narrowly oblong, tapering gradually toward the base, the whole 5 mm. long or less: racemes elongated; pedicels ascending, slender, about 5 mm. long: pods slender, 4–6 cm. long, somewhat divergent, arcuate; septum without a midrib; style truncate, stigma not bilobate.

Distribution: western New Mexico. Type: *Wooton 3347* from "low mountains west of San Antonio, Socorro County."

No specimens have been seen that could be referred to this species and its identity remains in doubt. From a geographical viewpoint it might be supposed to be most closely related to *T. ovalifolium* but the very long pods seem to distinguish it from that species.

7. *T. sagittatum* (Nutt.) Endl. in Walp. Rep. 1: 172. 1842; Wats. Bot. King's Exp. 25. 1871; Brewer & Wats. Geol. Survey Calif. Bot. 1: 37. 1876; Coulter, Manual Rocky Mountain Region, 21. 1885; Robinson in Gray, Syn. Fl. N. Am. 1¹: 175. 1895; Clements & Clements, Rocky Mountain Flowers, 28. 1914; Rydb. Fl. Rocky Mountains, 367. 1917.

Streptanthus sagittatus Nutt. Jour. Acad. Phila. 7: 12. 1834; Torr. & Gray, Fl. N. Am. 1: 76. 1838; Hook. & Arn. Bot. Beechey's Voy. 322. 1841; Walp. Rep. 1: 128. 1842; Dietr. Syn. Pl. 3: 729. 1843; Gray, Proc. Am. Acad. 6: 187. 1866.

Pachypodium sagittatum Nutt. in Torr. & Gray, Fl. N. Am. 1: 97. 1838; Dietr. Syn. Pl. 3: 702. 1843.

Thelypodium Nuttallii Wats. Bot. King's Exp. 26. 1871; Coulter, Manual Rocky Mountain Region, 21. 1885; Robinson in Gray, Syn. Fl. N. Am. 1¹: 176. 1895; Howell, Fl. Northwest Am. 58. 1897; Rydb. Fl. Rocky Mountains, 367. 1917.

?*T. amplifolium* Greene, Erythea 4: 173. 1896.

T. sagittatum Heller, Bull. Torr. Bot. Club 25: 265. 1898; Piper, Contr. U. S. Nat. Herb. 11: 298. 1906; Frye & Rigg, Northwest Fl. 179. 1912.

T. torulosum Heller, Bull. Torr. Bot. Club 25: 265. 1898; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 210. 1909; Frye & Rigg, Northwest Fl. 179. 1912; Garrett, Spring Fl. Wasatch Region, 48. 1912; Armstrong, Field Book Western Wild Flowers, 176, fig. 1915.

T. paniculatum A. Nelson, Bull. Torr. Bot. Club 26: 126. 1899; Rydb. Fl. Colo. 167. 1906; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 210. 1909; Daniels, Fl. Boulder, Colo. 135. 1911.

T. macropetalum Rydb. Bull. Torr. Bot. Club 29: 233. 1902; Rydb. Fl. Rocky Mountains, 367. 1917.

Biennial or short-lived perennial, glaucous, glabrous or sparsely hirsute near the base: stems usually branched from the base as well as upwards, erect or ascending, 3-7 dm. high: radical and lowermost cauline leaves entire, oblanceolate, 4-12 cm. long; stem-leaves ovate-lanceolate or narrower, auriculate at the base with broad lobes, usually acute: sepals purplish with scarious margins, not saccate at the base, somewhat unequal, 5-7 mm. long; petals white to deep purple, 2-3 times as long as the sepals, blade oblanceolate, gradually narrowed to the slender claw which nearly equals it in length; filaments 4-7 mm. long, anthers apiculate, about 2 mm. long; inflorescence corymbose, elongating and racemose when mature; pedicels divergent-ascending, nearly straight, enlarged at the apex, 5-12 mm. long; pods erect or strongly ascending, slender, frequently somewhat torulose, subsessile, 3-6 cm. long; style 1-1.5 mm. long, stigma entire: seeds irregularly angled, cotyledons obliquely accumbent.

Distribution: southwestern Wyoming, northern Colorado, southern Idaho, Utah, and northern Nevada. Type: *Wyeth* "on the banks of the Little Goddin River towards the sources of the Columbia." This is now known as the Little Lost River of Idaho.

Specimens examined:

Wyoming: Wheatland, June 18, 1891, *Nelson 58* (Rky. Mt. Herb.); saline flats, Kemmerer, June 13, 1900, *Nelson 7164* (Rky. Mt. Herb.); Fossil, June 12, 1898, *Nelson 4673* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); Evanston, May 29, 1897, *Nelson 3013* (Rky. Mt. Herb.); Evanston, June 5, 1898, *Nelson 4545* (Rky. Mt. Herb.).

Colorado: Camp Creek, Larimer County, July 6, 1903, *Goodding 1466* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); Grizzly Creek, July 24, 1896, *Baker* (Mo. Bot. Gard. Herb.).

Idaho: Soda Springs, June 21, 1892, *Mulford* (Mo. Bot. Gard. Herb.); Ketchum, June 24, 1892, *Mulford* (Mo. Bot. Gard. Herb.); Ketchum and Guyer Hot Springs, July 22, 1911, *Nelson & Macbride 1346* (Rky. Mt. Herb.); Picabo, July 1, 1916, *Macbride & Payson 2982* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); Hailey, Wood River, July 22, 1895, *Henderson 3248* (U. S. Nat. Herb.).

Utah: Logan, April 18, 1909, *Smith 1529* (Rky. Mt. Herb.); Logan, June 13, 1909, *Smith 1640* (Rky. Mt. Herb.); Brigham, Box Elder County, May 9, 1910, *Smith 2121* (Rky. Mt. Herb.); Stansbury Island, June 18, 1883, *Leonard* (Univ. Calif. Herb.); Juab, June 10, 1902, *Goodding 1085* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.).

Nevada: O'Neil, July 18, 1912, *Nelson & Macbride 2085* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.); Palisade, June 14, 1882, *Jones 3768* (Mo. Bot. Gard. Herb. and Clokey Herb.).

7a. Var. *crassicaarpum* Payson, n. var.¹

T. sagittatum Nelson, First Rept. Fl. Wyo. 205. 1896, as to specimens cited, not Endl.

T. torulosum Rydb. Mem. N. Y. Bot. Gard. 1: 171. 1900, not Heller.

Biennial, glaucous, very sparsely hirsute near the base: stems rather stout, erect, branching upwards: radical leaves entire, oblanceolate; cauline leaves auriculate at the base, usually obtuse at the apex: inflorescence corymbose; pedicels rather stout, 5-8 mm. long, divergent: pods 2-3.5 cm. long, stout, nearly 2 mm. in diameter.

Distribution: western Montana, northwestern Wyoming; Washington.

Specimens examined:

Montana: Alaska Basin, Madison County, June 20, 1899, *Nelson & Nelson 5474* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.).

Wyoming: Yellowstone Nat. Park, Aug. 5, 1885, *Letterman 13* (Mo. Bot. Gard. Herb.); Yellowstone Canyon, Aug. 24, 1899,

¹*Thelypodium sagittatum* (Nutt.) Endl. var. *crassicaarpum* var. nov., biennae; siliquis 2-3.5 cm. longis, crassis, 2 mm. latis.—Collected in Yellowstone Canyon, Wyoming, Aug. 24, 1899, *Aven Nelson & Elias Nelson 6663* (Mo. Bot. Gard. Herb., TYPE).

Nelson & Nelson 6663 (Rky. Mt. Herb. and Mo. Bot. Gard. Herb., TYPE); Jackson's Hole on Snake River, June 15, 1860, *Hayden* (Mo. Bot. Gard. Herb.); Bacon Creek, Uinta County, Aug. 15, 1894, *Nelson 922* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.).

Washington: 1889, *Vasey 194* (U. S. Nat. Herb.).

Much of the confusion and the involved synonymy that has obtained in regard to this species has been due to the effort to maintain *Streptanthus sagittatus* and *Pachypodium sagittatum* of Nuttall as distinct. It is altogether possible that Nuttall himself may not have regarded them as different and the confusion may have arisen because of a change in Nuttall's opinion as to the genus to which the species should be referred. The type of *S. sagittatus* was collected by Wyeth in 1833 on the "Little Goddin River" and of *P. sagittatum* presumably by Nuttall on "Plains on the west side of the Rocky Mountains" in 1834. The types are so fragmentary and immature as to make identification doubtful.

After a study of a considerable series of specimens it was found impossible to maintain as distinct the various segregates of this species recently proposed. Only two forms seem to stand out as separable—a southern one with slender pods and a northern one with thick pods. When mature these plants are easily separated and no intermediates have been seen; their ranges also seem to be constantly distinct. With the species thus limited the question arose as to the exact location from which the type specimens were secured. Nuttall on his trip to Oregon with Wyeth in 1834 followed the famous "Oregon Trail" and from the journal kept by Dr. Townsend, another member of the party, it seems certain that nowhere did they go far enough north to encounter the variety with thick pods. If the type of *Pachypodium sagittatum* was collected it was evidently the typical form. Wyeth's route in 1833 has also been carefully followed in order to learn the exact location of the "Little Goddin River" with the result that this has been identified with the "Little Lost River" of southern Idaho. To any one familiar with the topography of this region it is easy to follow the references to familiar landmarks and so locate without doubt the places that were visited. The form of the species that occurs in southern Idaho is also that which is here considered typical. Consequently these two names which have been maintained with so much diffi-

culty and confusion for so many years seem to have been applied to plants of the same species.

8. *T. stenopetalum* Wats. Proc. Am. Acad. 22: 468. 1887; Robinson in Gray, Syn. Fl. N. Am. 1¹: 176. 1895.

Probably biennial, glabrous and glaucous throughout: stem branched from the base, simple or sparingly branched above, slender, 3-6 dm. high: radical leaves soon withering, apparently oblanceolate, entire or repand; cauline leaves erect, sagittate at the base, narrowly lanceolate in outline, entire, acute, 3-5 cm. long: sepals purplish or green, linear, dorso-ventral pair slightly longer, hooded at the apex, about 1 cm. long; petals narrowly linear, somewhat crisped above, white or roseate, at least one-half longer than the sepals; filaments tetradynamous, linear, 8-14 mm. long; anthers coiled when dry, conspicuously apiculate, about 5 mm. long: inflorescence elongated, lax, racemose even before anthesis; pedicels ascending, 4-6 mm. long: pods slender, ascending, 4-5.5 cm. long, sessile; style not more than 1 mm. long, stigma very slightly 2-lobed.

Distribution: San Bernardino Mountains, southern California. Type: *Parish* "in Bear Valley, San Bernardino Mountains, on stony hillsides near the upper lake."

Specimens examined:

California: stony hillside, Upper Lake, Bear Valley, altitude 6500 ft., June, 1886, *S. B. Parish 1794* (Gray Herb., TYPE); same locality, June 16-20, 1895, *Parish 3787* (Gray Herb. and Univ. Calif. Herb.).

This is a most distinct species by virtue of the extraordinary petals. The septum is characteristically that of other members of this genus and there seems no reason to question its inclusion within *Thelypodium*.

9. *T. flexuosum* Robinson in Gray, Syn. Fl. N. Am. 1¹: 175. 1895; Howell, Fl. Northwest Am. 58. 1897; Frye & Rigg, Northwest Fl. 179. 1912.

Perennial, glabrous throughout: caudex clothed with the papery remains of previous leaf bases; stems 3-5 dm. long, slender, branched, subdecumbent, frequently flexuous, nearly naked above: radical leaves 8-15 cm. long, numerous, entire, lanceolate, gradually narrowed to the slender petiole; cauline leaves distant, lance-linear, acuminate, auriculate at the base with linear, acute lobes, the uppermost similar, much reduced: petals pale purplish

or white, spatulate, about twice as long as the sepals; filaments linear, anthers 1-2 mm. long, sagittate, not apiculate: inflorescence lax, at first corymbose, at maturity racemose; pedicels slender, divergent-ascending, 5-8 mm. long: pods conspicuously reticulate, irregularly torulose, shortly stipitate or subsessile, 15-22 mm. long; style slender, about 1 mm. long, stigma small, nearly circular: seeds not winged.

Distribution: eastern Oregon to northwestern Nevada. Type: Anderson from near Carson City, Nevada.

Specimens examined:

Oregon: alkaline plains, Malheur Butte, May 12, 1896, *Leiberg 2039* (Mo. Bot. Gard. Herb.); alkaline meadows, Powder River, May 23, 1898, *Cusick 1884* (Mo. Bot. Gard. Herb.); south of Big Springs, July 5, 1894, *Leiberg 396* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.).

Nevada: Minden, June 10, 1920, *Bethel* (Rky. Mt. Herb.); west of Antelope Valley, May 11, 1859, *H. Engelmann 77* (Mo. Bot. Gard. Herb.); Empire City, June 19, 1882, *Jones 3771* (Cloykey Herb.).

10. *T. laciniatum* (Hook.) Endl. in Walp. Rep. 1: 172. 1842; Wats. Bot. King's Exp. 26. 1871; Gray, Proc. Am. Acad. 8: 377. 1873; Torr. Bot. Wilkes' Exp. 17: 231. 1874; Brewer & Wats. Geol. Survey Calif. Bot. 1: 37. 1876; Robinson in Gray, Syn. Fl. N. Am. 1¹: 177. 1895, in part; Howell, Fl. Northwest Am. 58. 1897, in part; Piper & Beattie, Fl. Palouse Region, 82. 1901, in part; Piper, Contr. U. S. Nat. Herb. 11: 299. 1906, in part; Frye & Rigg, Northwest Fl. 180. 1912; Piper & Beattie, Fl. Southeastern Washington and Adj. Idaho, 117. 1914; Piper & Beattie, Fl. Northwest Coast, 173. 1915.

Macropodium laciniatum Hook. Bot. Misc. 1: 341, t. 68. 1830; Hook. Fl. Bor. Am. 1: 43. 1840; Dietr. Syn. Pl. 3: 695. 1843.

Pachypodium laciniatum Nutt. in Torr. & Gray, Fl. N. Am. 1: 96. 1838.

P. ciliatum Dietr. Syn. Pl. 3: 702. 1843.

Thelypodium neglectum Jones, Am. Nat. 17: 875. 1882, in part.

T. leptosepalum Rydb. Bull. Torr. Bot. Club 34: 433. 1907; Rydb. Fl. Rocky Mountains, 367. 1917.

Biennial, glabrous throughout, more or less glaucous: stems usually stout, in the larger plants hollow, irregularly branching upwards, 3-24 dm. high: radical leaves petioled, thick, deltoid-

lanceolate, 1–5 dm. long, irregularly and deeply lobed, lobes acute or obtuse; cauline leaves petioled, the upper deeply pinnatifid to subentire: sepals similar, pale, acute, 4–7 mm. long; petals white, nearly linear, 7–21 mm. long, about 1 mm. broad; filaments slightly broadened at the base, 5–15 mm. long, anthers apiculate, 2–4 mm. long; inflorescence racemose, dense even when mature, 1–6 dm. long; pedicels stout, frequently flattened at the base, horizontal, 3–5 mm. long; pods widely spreading or recurved, 3–10 cm. long, about 1 mm. wide, somewhat flattened parallel to the septum; stipe 2–4 mm. long; style about 1 mm. long, stigma circular: seeds not winged.

Distribution: Idaho, northern Nevada, eastern Washington, and Oregon; northeastern California. Type: *Douglas* from near Walla Walla and at Priest's Rapid, Columbia River.

Specimens examined:

Idaho: Shoshone Falls, May 27, 1899, *Trelease 3991* (Mo. Bot. Gard. Herb.); Twin Falls and Shoshone Falls, July 25, 1911, *Nelson & Macbride 1343* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.); Shoshone Falls, June 11, 1912, *Bennitt 156* (Rky. Mt. Herb.); Twin Falls, May 13, 1912, *Bennitt 39* (Rky. Mt. Herb.); about Lewiston, May 6, 1896, *Heller & Heller 3022* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.).

Nevada: Palisade, June 14, 1882, *Jones 3767* (Mo. Bot. Gard. Herb., Rky. Mt. Herb., and Clokey Herb.); Pyramid Lake, Washoe County, May 19, 1905, *Kennedy 1003* (Rky. Mt. Herb.); Pyramid Lake, June 1, 1913, *Kennedy 1975* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.); Carson City, May 29, 1897, *Jones* (Rky. Mt. Herb.).

Washington: Yakima Region, 1882, *Brandegge 377* (Univ. Calif. Herb.); Ritzville, June 8, 1893, *Sandberg & Leiber 190* (Mo. Bot. Gard. Herb.); Klickitat, 1879, *J. Howell* (Mo. Bot. Gard. Herb.); dry cliffs near Columbia River, Klickitat County, May 5–June, 1886, *Suksdorf 841* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.).

Oregon: 1871, *E. Hall 34* (Mo. Bot. Gard. Herb.); Barnhart, May 30, 1886, *Henderson 73* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); Ione, Morrow County, July 13, 1903, *Lunell* (Rky. Mt. Herb.); Pine Creek, Gilliam County, June 7, 1894, *Leiber 190* (Mo. Bot. Gard. Herb.); The Dalles, Aug., 1898, *Savage, Cameron & Lenocker* (Mo. Bot. Gard. Herb.).

California: near Yreka, Siskiyou County, May 23, 1876, *Greene 803* (Mo. Bot. Gard. Herb.); hills west of Big Pine, Inyo

County, May 15, 1906, *Heller 8262* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); near Big Pine, May 30, 1906, *Hall & Chandler 7226* (Univ. Calif. Herb.).

A rather polymorphic species occurring in its typical form in eastern Washington and Oregon where it is characterized by slender, acute leaf segments. The type of *T. leptosepalum* accords very well with the drawing that accompanies the original description of *T. laciniatum* by Hooker.

10a. Var. *streptanthoides* (Leiberg) Payson, n. comb.

T. laciniatum Piper & Beattie, Fl. Palouse Region, 82. 1901, in part.

T. streptanthoides Leiberg, Contr. U. S. Nat. Herb. 11: 299. 1906; Piper & Beattie, Fl. Southeastern Washington and Adj. Idaho, 117. 1914.

Leaves rather thin, deeply pinnatifid, lobes acute, narrow: sepals slightly saccate at the base, purple, at least on the upper third; petals white, linear: pedicels horizontal: pods recurved, glabrous, 6–12 cm. long.

Distribution: eastern Washington and Oregon. Type: *Sandberg & Leiberg 229* from "near Wilson Creek, Douglas County, Washington."

Specimens examined:

Washington: Almota, May 27, 1893, *Piper 1473* (Rky. Mt. Herb.); junction Crab and Wilson Creeks, Douglas County, June 19, 1893, *Sandberg & Leiberg 229* (Mo. Bot. Gard. Herb.).

Oregon: Riparia, May 31, 1905, *Jones* (Mo. Bot. Gard. Herb.); The Dalles, May 4, 1906, *Lunell* (Rky. Mt. Herb.).

Aside from the conspicuous color of the sepals little difference seems to exist between the variety and the typical form of the species. The leaves are said to be thinner and not at all glaucous. It is extremely doubtful, however, if this correlation will be found to be without exception, and further collections may show this plant deserving of formal rank only.

10b. Var. *milleflorum* (A. Nelson) Payson, n. comb.

T. laciniatum Robinson in Gray, Syn. Fl. N. Am. 1st: 177. 1895, in part; Howell, Fl. Northwest Am. 58. 1897, in part; Piper, Contr. U. S. Nat. Herb. 11: 299. 1906, in part.

T. milleflorum A. Nelson, Bot. Gaz. 52: 263. 1911; Frye & Rigg, Northwest Fl. 180. 1912; Rydb. Fl. Rocky Mountains, 367. 1917.

Glabrous and glaucous, stout: leaves thick, not so deeply lobed as in the species, the uppermost frequently nearly entire: sepals white, about 5 mm. long; petals linear-spatulate, 6–12 mm. long; filaments 7–10 mm. long, anthers apiculate: mature inflorescence dense, pedicels curved upwards, 3–4 mm. long: pods erect or strongly ascending, 2.5–6 cm. long, stipe 1–2 mm. long.

Distribution: Idaho, northern Nevada, eastern Washington, Oregon, and California. Type: *Macbride 234* from New Plymouth, Idaho.

Specimens examined:

Idaho: Shoshone, June 21, 1892, *Mulford* (Mo. Bot. Gard. Herb.); New Plymouth, June 10, 1910, *Macbride 234* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb., TYPE); New Plymouth, May 2, 1911, *Macbride 796* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); Pocatello, 1912, *Turesson 42* (Rky. Mt. Herb.); Arco, Blaine County, July 8, 1916, *Macbride & Payson 3094* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); Idaho Falls, June 19, 1920, *Payson & Payson 1798* (Mo. Bot. Gard. Herb.).

Nevada: Simpson's Park, July 6, 1859, *H. Engelmann* (Mo. Bot. Gard. Herb.); Sprucemont, July 22, 1891, *Jones* (Univ. Calif. Herb.); Palisade, June 14, 1882, *Jones 3772* (Clokey Herb.); Reno, May, 1890, *Sonne* (Univ. Calif. Herb.); Carson City, May 29, 1897, *Jones* (Mo. Bot. Gard. Herb.); Eagle Valley, Ormsby County, June 7, 1902, *Baker 1020* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.).

Washington: Yakima County, 1883, *Brandegee 637* (Univ. Calif. Herb.); base of Rattlesnake Mountains, Yakima region, May 31, 1901, *Cotton 391* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.).

Oregon: dry bottoms, Malheur County, June 21, 1898, *Cusick 1965* (Mo. Bot. Gard. Herb., Rky. Mt. Herb., and Univ. Calif. Herb.).

California: Great Basin, Sierra Valley, July, 1875, *Lemmon 40* (Mo. Bot. Gard. Herb.).

With a limited series of specimens this variety seems quite distinct from the species because of the strongly ascending pods. With a more complete series, however, it is impossible to draw the dividing line definitely. In addition to this intergrading the distribution is very similar and it is therefore thought best to regard *milleflorum* as worthy of varietal distinction only.

11. *T. rhomboideum* Greene, *Pittonia* 4: 314. 1901.

T. integrifolium Robinson in Gray, *Syn. Fl. N. Am.* 1¹: 176. 1895, in part.

Pleurophragma platypodum Rydb. *Bull. Torr. Bot. Club* 34: 434. 1907; Rydb. *Fl. Rocky Mountains*, 368. 1917.

Biennial, glabrous: stems erect, usually simple at the base and paniculately branched above, 4-14 dm. high: radical leaves oblanceolate, entire or sinuate-margined, 4-12 cm. long, usually obtuse; cauline leaves narrowly lanceolate to linear, reduced upwards, sessile or subsessile: sepals white or pale purple; petals white, narrowly spatulate, 6-8 mm. long; filaments 5-7 mm. long, anthers about 2 mm. long, not apiculate; nectar glands 4, horn-like processes: inflorescence very dense, scarcely corymbose; pedicels 3-5 mm. long, horizontal or somewhat reflexed, flattened conspicuously at the base: pods incurved, ascending, irregularly torulose, 2-3 cm. long; stipe 1-2 mm. long; style about 1 mm. long, stigma small, entire or slightly 2-lobed over the valves.

Distribution: western Colorado, Utah, and Nevada. Type: Greene from "the west Humboldt Mountains, Nevada."

Specimens examined:

Colorado: Hayden, Routt County, Aug. 6, 1903, *Goodding* 1789 (*Mo. Bot. Gard. Herb. and Rky. Mt. Herb.*); Hot Sulphur Springs, Middle Park, Aug. 1, 1881, *G. Engelmann* (*Mo. Bot. Gard. Herb.*); Montrose or Ridgway, 1897, *Bethel* (*Bethel Herb.*).

Utah: Moab, Aug. 30, 1891, *Jones* (*Univ. Calif. Herb., Rky. Mt. Herb., and Mo. Bot. Gard. Herb.*).

Arizona: near Tuba, Painted Desert, July 15-31, 1920, *Clute* 82 (*Mo. Bot. Gard. Herb.*).

Nevada: spring in pass of Goshoot Mountains, July 20, 1859, *H. Engelmann* 111 (*Mo. Bot. Gard. Herb.*); Wadsworth, Aug., 1876, *E. Palmer* 22 (*Univ. Calif. Herb. and Mo. Bot. Gard. Herb.*); Reno, Aug. 13, 1889, *Hillman* (*Univ. Calif. Herb.*); Truckee Pass, Washoe County, Sept. 15, 1909, *Heller* 9958 (*Mo. Bot. Gard. Herb.*).

It has been impossible to examine the type specimen of *T. rhomboideum*, since it can not be located at the Greene Herbarium at Notre Dame nor in other collections in which it might be expected. This uncertainty as to the identity of the type is complicated because the original description is far from complete. However, since only one species of this group is known

from the type locality of *T. rhomboideum* and since that species seems identical with the plant described as *T. platypodum*, the two are here united under the older name.

11a. Var. *gracilipes* (Robinson) Payson, n. comb.

T. integrifolium Endl. var. ? Brandegee in Hayden, Bull. Geol. & Geog. Survey of the Territories 2: 233. 1876.

T. integrifolium var. *gracilipes* Robinson in Gray, Syn. Fl. N. Am. 1st: 176. 1895; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 209. 1909.

Thelypodium gracilipes Rydb. Fl. Colo. 167. 1906.

Pleurophragma gracilipes Rydb. Bull. Torr. Bot. Club 34: 433. 1907; Wootton & Standley, Contr. U. S. Nat. Herb. 19: 268. 1915; Rydb. Fl. Rocky Mountains, 368. 1917.

Sepals white or nearly so; petals white; nectar glands as in the species; stipe 2–3 mm. long.

Distribution: southwestern Colorado, northwestern New Mexico, and Utah. Type: *Brandegee 1233* from southwestern Colorado.

Specimens examined:

Colorado: Bedrock, Montrose County, Aug. 2, 1912, *Walker 369* (Rky. Mt. Herb.); banks of the San Juan River, Aug., 1875, *Brandegee 4278* (Mo. Bot. Gard. Herb.).

Utah: Armstrong and White Canyons, near the Natural Bridges, Aug. 4–6, 1911, *Rydberg & Garrett 9429* (Rky. Mt. Herb.).

12. *T. integrifolium* (Nutt.) Endl. Walp. Rep. 1: 172. 1842; Robinson in Gray, Syn. Fl. N. Am. 1st: 176. 1895; Howell, Fl. Northwest Am. 58. 1897; Piper, Contr. U. S. Nat. Herb. 11: 299. 1906; Frye & Rigg, Northwest Fl. 180. 1912.

Pachypodium integrifolium Nutt. in Torr. & Gray, Fl. N. Am. 1: 96. 1838; Dietr. Syn. Pl. 3: 702. 1843.

Pleurophragma integrifolium Rydb. Bull. Torr. Bot. Club 34: 433. 1907, in part.

Biennial, glabrous throughout: stems erect, stout, branching, 6–15 dm. high: radical leaves oblong-elliptical, 1–3 dm. long, gradually narrowed to a broad petiole; cauline leaves linear-lanceolate, narrowed to a slender base, much reduced upwards and becoming linear in the inflorescence: petals spatulate, about 8 mm. long, exceeding the sepals by about one half, bluish or pale rose color; anthers about 2 mm. long, not apiculate; nectar glands

well developed into 2 pairs of horn-like processes: inflorescence at first corymbose, when mature somewhat elongated but remaining dense; pedicels 5–8 mm. long, slender and terete but usually somewhat wing-margined at the very base, horizontal or slightly ascending: pods irregularly torulose, arcuate, ascending, 2–3 cm. long, stipe 1–2 mm. long; styles less than 1 mm. long, stigmas small, entire: seeds frequently apiculate.

Distribution: Washington and Oregon. Type: *Nuttall* from "elevated plains of the Rocky Mountains towards the Oregon, as far as Wallawallah."

Specimens examined:

Washington: Satus, Yakima County, July, 1898, *Elmer 1073* (Mo. Bot. Gard. Herb.); Squaw Creek, Yakima County, Aug. 26, 1902, *Cotton 874* (Mo. Bot. Gard. Herb.); near Ellensburg, Sept., 1883, *Brandegee 636* (Univ. Calif. Herb.).

Oregon: valley of the Ochoco, July 23, 1901, *Cusick 2694* (Univ. Calif. Herb., Rky. Mt. Herb., and Mo. Bot. Gard. Herb.); near Prineville, Crook County, Aug. 26, 1894, *Leiberg 817* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.).

The identity of Nuttall's type of this species seems definitely established. The original description coincides more closely with the northwestern plant than with the nearly related species. Mr. J. F. Macbride who kindly examined a specimen at the Gray Herbarium that is evidently a co-type, writes me that the plant of Nuttall has pedicel bases that are definitely broadened and the pedicels themselves are about 6 mm. long. This broadening of the pedicel bases is characteristic of Washington material. The habitat as originally given would seem to indicate that the type locality was in the far northwest.

13. *T. affine* Greene, *Pittonia* 4: 314. 1901.

T. integrifolium Brewer & Wats. Geol. Survey Calif. Bot. 1: 37. 1876; Greene, Fl. Franciscana, 262. 1891; Robinson in Gray, Syn. Fl. N. Am. 1¹: 176. 1895, in part.

Biennial, glabrous throughout, glaucescent: stem stout, paniculately branching above: radical leaves 10–25 cm. long, thick, oblanceolate, obtuse, irregularly margined or entire, blade narrow to a broadly winged petiole: petals white (?), narrowly spatulate, 7–10 mm. long, much exceeding the sepals; stamens slightly exserted, anthers about 2 mm. long; nectar glands 2 (each pair coherent), well developed: inflorescence dense, scarcely corymbose; pedicels stout, nearly horizontal, 8–10 mm. long,

somewhat flattened at the base: pods horizontal-ascending, flattened laterally, 3–4.5 cm. long; stipe 1–2 mm. long; style stout, usually less than 1 mm. long, stigma small, entire.

Distribution: southern California. Type: *Greene*, from "mountains near Tehachapi."

Specimens examined:

California: Mojave Desert, Aug., 1881, *Parry* (Mo. Bot. Gard. Herb.); Mojave Desert, May, 1882, *Parish 1435* (Mo. Bot. Gard. Herb.); Victor, San Bernardino County, June 25–27, 1888, *E. Palmer 225* (Mo. Bot. Gard. Herb.); Rancho Verde, Victorville, San Bernardino County, June 25, 1915, *Parish 10532* (Univ. Calif. Herb.); Rabbit Springs, Mojave Desert, Aug., 1882, *S. B. & W. F. Parish 1485* (Univ. Calif. Herb.).

14. *T. lilacinum* Greene, Pl. Baker. 3: 9. 1901.

Pachypodium integrifolium Hook. Hooker's London Jour. Bot. 6: 70. 1847, not Nutt.

Thelypodium integrifolium Torr. & Gray, Pac. Rail. Rept. 2: 126. 1855; Porter & Coulter, Syn. Fl. Colo. 9. 1874; Coulter, Manual Rocky Mountain Region, 21. 1885; Robinson in Gray, Syn. Fl. N. Am. 1: 176. 1895, in part; Nelson, First Rept. Fl. Wyo. 204. 1896; Britton & Brown, Ill. Fl. 2: 110. 1897, and ed. 2, 2: 169. 1913; Britton, Manual, 444. 1901; Rydb. Fl. Colo. 167. 1906; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 209. 1909; Petersen, Fl. Nebraska, 60. 1912; Clements & Clements, Rocky Mountain Flowers, 28. 1914; Bergman, Flora North Dakota, 193. 1918.

Pleurophragma integrifolium Rydb. Bull. Torr. Bot. Club 34: 433. 1907, in part; Wootton & Standley, Contr. U. S. Nat. Herb. 19: 267. 1915; Rydb. Fl. Rocky Mountains, 368. 1917, in part.

Biennial, glabrous throughout: stems erect, branched from the base or simple, paniculately branched above, 3–24 dm. high: radical leaves entire, oblanceolate, 4–12 cm. long, obtuse; cauline leaves narrowly lanceolate to linear, reduced upwards, sessile by a narrow base or slightly auriculate: sepals purple to white; petals spatulate, 7–9 mm. long, purple, pale blue, lilac or nearly white; anthers 2–3 mm. long; nectar glands low and rounded: inflorescence at first corymbose, elongating when mature, frequently rather lax; pedicels horizontal or ascending, slender, 5–10 mm. long, not conspicuously flattened at the base: pods irregularly torulose, arcuate-ascending, 1.5–3.5 cm. long; stipe usually less than 1 mm. long; style about 1 mm. long, stigma entire.

Distribution: western Nebraska, southern Wyoming, Colorado, northwestern New Mexico, Utah, and southern Idaho. Type: *Baker 635* from Doyle's, Gunnison County, Colorado.

Specimens examined:

Nebraska: sandhills of the Platte, Aug., 1855, *Hayden* (Mo. Bot. Gard. Herb.); north fork of the Platte, toward Ft. Laramie, July, 1858, *H. Engelmann 110* (Mo. Bot. Gard. Herb.); south fork of the Platte, July, 1856, *H. Engelmann* (Mo. Bot. Gard. Herb.); Bridgeport, Cheyenne County, Aug. 6, 1901, *Baker* (Mo. Bot. Gard. Herb.).

Wyoming: Lusk, July 21, 1894, *Nelson 574* (Mo. Bot. Gard. Herb.); Laramie, Aug. 10, 1895, *Nelson 1663* (Rky. Mt. Herb.); open, saline soils, Albany County, July 16, 1900, *Nelson 7606* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); Jones' Ranch, Albany County, July 24, 1903, *Nelson* (Rky. Mt. Herb.); Laramie, July 28, 1913, *Macbride 2569* (Mo. Bot. Gard. Herb.); Laramie, Sept. 20, 1913, *Sharp 432* (Rky. Mt. Herb.); Wind River, near Dubois, Aug. 9, 1894, *Nelson 747* (Rky. Mt. Herb.); Granger, Hams Fork, July 30, 1897, *Nelson 4140* (Rky. Mt. Herb.); near Ft. Bridger, Aug., 1872, *Leidy* (Mo. Bot. Gard. Herb.).

Colorado: lat. 40–41°, *Vasey* (Mo. Bot. Gard. Herb.); lat. 41°, 1862, *Hall & Harbour 51* (Mo. Bot. Gard. Herb.); 1909, *Johnston 598* (Rky. Mt. Herb.); New Windsor, July 22, 1901, *Osterhout* (Rky. Mt. Herb.); Fort Collins, Aug. 8, 1895, *Crandall* (Mo. Bot. Gard. Herb.); banks of the Cache le Poudre River near Fort Collins, Aug. 9, 1898, *Crandall* (Rky. Mt. Herb.); Wet Mountain Valley, Aug., 1873, *Brandeggee 821* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); Hot Sulphur Springs, Aug. 1, 1881, *G. Engelmann* (Mo. Bot. Gard. Herb.); near Hot Sulphur Springs, Aug. 3–8, 1907, *Ramaley & Robbins 3627* (Rky. Mt. Herb.); Parlins, June, 1888, *Eastwood* (Bethel Herb.); Doyle's, July 29, 1901, *Baker 365* (Mo. Bot. Gard. Herb.).

Idaho: near Clayton, Custer County, July 22, 1916, *Macbride & Payson 3360* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.); Blackfoot, Aug. 9, 1892, *Mulford* (Mo. Bot. Gard. Herb.); Twin Falls and Shoshone Falls, July 26, 1911, *Nelson & Macbride 1349* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.).

Utah: Logan, Aug. 12, 1909, *Smith 2003* (Rky. Mt. Herb.); near Midway, Wasatch County, July 6, 1905, *Carlton & Garrett 6705* (Rky. Mt. Herb.); Ephraim, June 27, 1894, *Jones 5522* (Mo.

Bot. Gard. Herb.); along the Sevier River, above Marysville, July 19, 1905, *Rydb. & Carlton 6926* (Rky. Mt. Herb.).

The group of specimens here cited is more or less polymorphic but it is believed that further taxonomic segregation would be of no advantage. Color differences are difficult of detection in the herbarium, and there is every reason to believe that the colors are quite variable in the field although some geographic localization of color forms certainly occurs. In Colorado, for example, the form on the eastern slope of the Continental Divide is mostly white-flowered and on the western slope mostly purple. This purple form of western Colorado is the typical *lilacinum* of Greene. In Utah white-flowered plants seem to predominate, while in southern Idaho the purple-flowered form again appears.

14a. Var. *subumbellatum* Payson, n. var.¹

Thelypodium integrifolium Robinson in Gray, Syn. Fl. N. Am. 1¹: 176. 1895, in part; Rydb. Mem. N. Y. Bot. Gard. 1: 172. 1900; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 209. 1909, in part.

Pleurophragma integrifolium Rydb. Fl. Rocky Mountains, 368. 1917, in part.

Radical leaves oblanceolate, 8–15 cm. long, 1.5–2.5 cm. broad, narrowed to a broad petiole: nectar glands low and rounded: mature inflorescence congested, subumbellate, 2–3 cm. long; pedicels slender, terete: stipes 0.5–1 mm. long.

Distribution: southwestern Montana, western Wyoming, southern Idaho, Utah.

Specimens examined:

Montana: Prickly Pear, July 15, 1898, *E. N. B.* (Univ. Calif. Herb.); Helena, 1887, *Kelsey 257* (Univ. Calif. Herb.); Deep Creek near Anaconda, Aug. 24, 1905, *Jones* (Mo. Bot. Gard. Herb.); alkali flats, Three Forks, Aug. 10, 1899, *Blankinship* (Mo. Bot. Gard. Herb.).

Wyoming: near Mammoth Hot Springs, Yellowstone Nat. Park, Aug., 1893, *Burglehaus* (Mo. Bot. Gard. Herb., TYPE, and Rky. Mt. Herb.); Mammoth Hot Springs, July 2, 1899, *Nelson & Nelson 6034* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); Mammoth Hot Springs, July 8, 1900, *Jones* (Univ. Calif. Herb.);

¹*Thelypodium lilacinum* Greene, var. *subumbellatum* var. nov., biennae glabrum; foliis radicalibus oblanceolatis 8–15 cm. longis 1.5–2.5 cm. latis; racemis fructiferis densis subumbellatis; pedicellis gracilibus teretibus.—Collected by F. H. Burglehaus near Mammoth Hot Springs, Yellowstone National Park, Wyoming, Aug., 1893. (Mo. Bot. Gard. Herb., TYPE).

Yellowstone Nat. Park, July, 1904, *Oleson 242* (Rky. Mt. Herb.).

Idaho: saline flats, American Falls, July 28, 1911, *Nelson & Macbride 1380* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.).

Utah: 1847, *Parry* (Mo. Bot. Gard. Herb.).

CHLOROCRAMBE

CHLOROCRAMBE Rydb. Bull. Torr. Bot. Club 34: 435 1907.

Perennial herb with rather stout, erect stem and thin, petioled, more or less hastate leaves. Flowers greenish yellow in a loose, virgate raceme, slightly deflexed; sepals similar, spreading; petals dentate or laciniately toothed laterally. Pods widely spreading, subterete, shortly stipitate; stigma entire; cells of septum elongated parallel to the replum, not tortuous. Seeds neither winged nor margined; cotyledons obliquely accumbent. Generic type: *C. hastata* (Wats.) Rydb.

1. *C. hastata* (Wats.) Rydb. Bull. Torr. Bot. Club 34: 435. 1907; Rydb. Fl. Rocky Mountains, 365. 1917.

Caulanthus hastatus Wats. Bot. King's Exp. 28. t. 3. 1871; Robinson in Gray, Syn. Fl. N. Am. 1^a: 173. 1895; Howell, Fl. Northwest Am. 47. 1897; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 210. 1909; Garrett, Spring Flora of the Wasatch Region, 48. 1912.

Perennial, glabrous throughout: stem erect, simple or sparingly branched, rather stout, 6-15 dm. high: all except the uppermost leaves ample; blade broadly deltoid, hastate or lanceolate, entire or coarsely and irregularly lobed, 5-10 cm. long, base usually truncate, at times subcordate; petioles of lower leaves 8-15 cm. long, becoming shorter above, frequently appendaged with several entire or irregularly lobed segments of the blade; uppermost leaves narrowly lanceolate, entire, much reduced: sepals greenish white, nearly equal, not saccate at the base, narrowly lanceolate, about 6 mm. long, slightly spreading, distant; petals whitish, somewhat exceeding the sepals, irregularly dentate or sublaciniate laterally towards the base, narrower and frequently linear above; filaments linear, slightly enlarged near the base, distinctly longer than the petals, anthers 3-4 mm. long, apiculate; nectar glands rather well developed: inflorescence racemose; pedicels deflexed-divaricate, enlarged at the apex, somewhat laterally compressed at the base, 7-10 mm. long: pods widely spreading, subterete, slightly flattened parallel

to the septum, 4-7 cm. long; stipe 1-7 mm. long; style very short, stigma capitate, entire; cotyledons in seed obliquely accumbent.

Distribution: from central Utah to southeastern Oregon. Type: *Watson 114* from "shaded slopes in the Wahsatch and Uinta Mountains," Utah.

Specimens examined:

Utah: American Fork Canyon, July 31, 1880, *Jones 1358* (Mo. Bot. Gard. Herb.).

Oregon: Wallowa Mountains, near the lake, July 31, 1899, *Cusick 2292* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.).

CAULANTHUS

CAULANTHUS Wats. Bot. King's Exp. 27. 1871; Brewer & Wats. Geol. Survey Calif. Bot. 1: 36. 1876; Robinson in Gray, Syn. Fl. N. Am. 1st: 172. 1895; Rydb. Fl. Rocky Mountains, 364. 1917.

Streptanthus Gray, Proc. Am. Acad. 6: 182. 1866, in part; Greene, Fl. Franciscana, 256. 1891, in part.

Stanfordia Wats. in Brewer & Wats. Geol. Survey Calif. Bot. 2: 479. 1880.

Thelypodium Greene, Fl. Franciscana, 262. 1891, in part; Robinson in Gray, Syn. Fl. N. Am. 1st: 173. 1895, in part; Jepson, Fl. West. Mid. Calif. 212. 1901, and ed. 2, 180. 1911; Rydb. Fl. Rocky Mountains, 366. 1917, in part.

Guillenia Greene, Leaf. Bot. Obs. & Crit. 1: 227. 1906, in part.

Mostly annual herbs, frequently glabrous and glaucous or in some species pubescent with simple trichomes. Stems branched or unbranched, slender, stout or conspicuously inflated. Except in a few species the radical leaves do not form a conspicuous rosette and are not sharply differentiated from the cauline leaves. Cauline leaves amplexicaul, sessile or petioled. Flowers purple, white or yellow; calyx segments equal or quite unequal; petals frequently narrow and crisped, blade usually not differentiated from the claw. Inflorescence usually racemose. Pods divaricate, erect or deflexed, usually glabrous, terete (if flattened not over 3 mm. wide), sessile or nearly so; style usually short, stigma entire or 2-lobed with the lobes extended over the center of the valves; cells of the septum usually short and the boundaries straight. Seeds wingless or narrowly winged; cotyledons usually obliquely incumbent. Generic type: *C. crassicaulis* (Torr.) Wats.

KEY TO THE SPECIES

- A. Cauline leaves sessile and auriculate at the base.
- a. Glabrous or inconspicuously short-pubescent.
- I. Stems not conspicuously inflated.
- *Stigma entire or shallowly 2-lobed; cotyledons entire.
1. Pods erect or divaricate.
0. Pods 6-8 cm. long; flowers purplish ----- 1. *C. amplexicaulis*
00. Pods about 1.5 cm. long; flowers yellow ----- 2. *C. sulfureus*
2. Pods reflexed ----- 9. *C. Cooperi*
- **Stigma deeply 2-lobed; cotyledons trifid. ----- 14. *C. californicus*
- II. Stems conspicuously inflated; stigma deeply 2-lobed; pods erect or divaricate. ----- 3. *C. inflatus*
- b. More or less hirsute or pilose.
- I. Seeds not winged or margined; pods nearly or quite terete.
- *Stigma distinctly 2-lobed.
1. Pods 4-14 cm. long; cotyledons entire.
0. Pods usually reflexed.
- x. Stigma shallowly 2-lobed; calyx yellowish ----- 10. *C. simulans*
- y. Stigma deeply 2-lobed; calyx purple ----- 11. *C. Coulteri*
00. Pods erect, 8-13 cm. long ----- 12. *C. Lemmonii*
2. Pods 2-4 cm. long; cotyledons trifid. ----- 14. *C. californicus*
- **Stigma very small, nearly entire ----- 15. *C. stenocarpus*
- II. Seeds narrowly winged; pods compressed or quadrangular, reflexed ----- 13. *C. heterophyllus*
- B. Cauline leaves sessile or petioled, not auriculate.
- a. Stem conspicuously inflated.
- I. Calyx glabrous.
- *Mature stigma shallowly 2-lobed. ----- 7. *C. major*
- **Mature stigma deeply 2-lobed ----- 8a. *C. crassicaulis* var. *glaber*
- II. Calyx densely hispid.
- *Annual; leaves more or less hispid ----- 6. *C. Hallii*
- **Short-lived perennial; leaves glabrous. ----- 8. *C. crassicaulis*
- b. Stem not inflated.
- I. Calyx densely hispid.
- *Annual; leaves hispid ----- 6. *C. Hallii*
- **Short-lived perennial; leaves glabrous. ----- 8. *C. crassicaulis*
- II. Calyx glabrous or sparsely pilose.
- *Pods erect or divaricate.
1. Style short, enlarged to a conspicuous stigma, not conic.
0. Plant glabrous.
- x. Tuft of radical leaves not persisting; annual ----- 4. *C. glaucus*
- y. Tuft of radical leaves persisting; short-lived perennial ----- 7. *C. major*
00. Plant densely pilose ----- 5. *C. pilosus*
2. Style 2-4 mm. long, conic; stigma minute.
0. Flowers large, yellow; petals crisped, 9-15 mm. long ----- 16. *C. flavescens*
00. Flowers not over 5 mm. long; petals flat.
- x. Sepals purplish, spreading. ----- 17. *C. anceps*

y. Sepals green or yellow,
erect.

†Pods slender on slender
pedicels -----18a. *C. lasiophyllus*
var. *inalienus*

††Pods stout on very
stout pedicels -----18b. *C. lasiophyllus* var.
rigidus

**Pods reflexed.

1. Lobes of the leaves usually acute;
plants of the coastal region-----18. *C. lasiophyllus*

2. Lobes of the leaves usually rounded,
leaves thinner, more nearly glab-
rous; plants of the interior-----18c. *C. lasiophyllus* var.
utahensis

1. *C. amplexicaulis* Wats. Proc. Am. Acad. 17: 364. 1882; Robinson in Gray, Syn. Fl. N. Am. 1': 172. 1895.

Euchisia amplexicaulis Greene, Leatl. Bot. Obs. & Crit. 1: 84. 1904.

Annual, glabrous throughout, more or less glaucous: stem slender, somewhat decumbent at the base, simple or branched, flexuous, 2-4 dm. long: stem-leaves from suborbicular to ovate or oblong, obtuse, 2-5 cm. long, deeply amplexicaul at the base, basal lobes rounded, leaf margin entire or in the lower leaves sinuate-dentate: sepals purplish, somewhat saccate above the base, particularly the dorso-ventral pair, nearly equal in length, about 7 mm. long; petals purplish, broadly linear, about 11 mm. long, upper part strongly crisped and becoming coiled; filaments linear, tetradynamous, 4-7 mm. long, anthers about 5 mm. long, scarcely apiculate: inflorescence lax, racemose; pedicels ascending or divaricate, 12-20 mm. long: pods spreading, curved, terete, slender, 6-8 cm. long; stipe stout, less than 1 mm. long; style not over 1 mm. long, stigma small, entire; cells of septum rectangular, short, not at all tortuous.

Distribution: southern California. Type: *S. B. & W. F. Parish* from the San Bernardino Mountains.

Specimens examined:

California: San Bernardino Mountains, *W. G. Wright* (Univ. Calif. Herb.); San Bernardino Mountains, April, 1881, *S. B. & W. F. Parish 846* (Mo. Bot. Gard. Herb.); head of Waterman's Canyon, June 6, 1892, *Parish 2326* (Univ. Calif. Herb.); head of Waterman's Canyon, San Bernardino Mountains, June, 1894, *Parish* (Univ. Calif. Herb.); Grass Valley, San Bernardino Mountains, June 28, 1894, *Parish 3036* (Mo. Bot. Gard. Herb.); Mill Creek, at the falls, San Bernardino Mountains, May 30, 1898, *Hall 918* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); Manzana, Antelope Valley, May 9-24, 1896, *Davy 2563* (Univ. Calif. Herb.);

near Manzana, Antelope Valley, May 9-24, 1896, *Davy 2469* (Univ. Calif. Herb.); Lytle Creek Canyon, San Antonio Mountains, June 1-3, 1900, *Hall 1436* (Univ. Calif. Herb.); Mt. San Antonio, San Bernardino County, July 12, 1902, *Abrams 2699* (Mo. Bot. Gard. Herb.); San Francisquito Pass, May 3, 1902, *Hall 3101* (Univ. Calif. Herb.).

Because of the entire stigma this plant is somewhat anomalous in *Caulanthus* and approaches the *Sisymbrioid* genera. The floral characters are, however, those of *Caulanthus* and in this group it seems to find its nearest allies.

So closely related to this species is *Streptanthus campestris* Wats. that in an immature condition the two are likely to be confused. That species seems to be biennial rather than annual, is a stouter plant than *C. amplexicaulis*, has winged seeds and a septum with tortuous cell walls. The sepals in the *Caulanthus* species are glabrous, while in *S. campestris* they are sparingly hirsute at the apex. *S. campestris* might, without offense to phylogeny, be united with *Caulanthus* except that there is perhaps a more definite line of cleavage between this species and *Caulanthus* than between it and other *Streptanthus* species. Accordingly, unless *Streptanthus* be merged with *Caulanthus*, here is the logical point of division.

2. *C. sulfureus* Payson, n. sp.¹

Root and lower part of the stem unknown, glabrous and glaucous above: stem branched in the inflorescence, rather stout: upper cauline leaves ovate, acuminate, amplexicaul at the base with rounded lobes, 3-5 cm. long: sepals yellowish, nearly equal, about 5 mm. long, lateral pair slightly saccate at the base; petals yellow, oblanceolate, 1-1.5 times as long as the sepals, scarcely clawed, margin slightly sinuate-dentate; filaments distinct, strongly tetradynamous, linear, 3-5 mm. long, anthers shortly apiculate, 2-3 mm. long; nectar glands 4, well developed: inflorescence corymbose or shortly racemose at first, elongating when mature; pedicels slender, ascending, 10-13 mm. long: pods

¹*Caulanthus sulfureus* sp. nov., glabrus glaucus; radice et caule inferno ignoto, caule superno ramoso robusto; foliis caulinis integris ovatis acuminatis 3-5 cm. longis amplexicaulibus, lobis basi rotundis; sepalis subflavis circiter 5 mm. longis, lateralibus subsaccatis, petalis flavis oblanceolatis 5-8 mm. longis, filamentis tetradynamis 3-5 mm. longis distinctis; inflorescentiis primo corymbosis, serius racemosis, pedicellis gracilibus patentibus 10-13 mm. longis; siliquis (immaturis) erectis subsessilibus circiter 1.5 cm. longis, stylo 1.5 mm. longo, stigmate subbilobo.—Collected on Santa Cruz bottoms near Tucson, Arizona, March 13-April 23, 1903, David Griffiths 4058 (Mo. Bot. Gard. Herb., TYPE).

(immature) erect or ascending, terete, subsessile, about 1.5 cm. long; style rather stout, 1.5 mm. long, stigma capitate, in age 2-lobed; cells of septum short, rectangular, not at all tortuous.

Distribution: southern Arizona.

Specimen examined:

Arizona: Santa Cruz bottoms near Tucson, March 13–April 23, 1903, *David Griffiths 4058* (Mo. Bot. Gard. Herb., TYPE).

The generic affinities of this plant are not quite clear. The position of the stigmatic lobes, which are definitely over the valves, excludes the possibility of allying it with those species recently segregated as *Thelypodiopsis*, and to which the plant bears considerable habital resemblance. *Thelypodium* is also, for the present, excluded for several reasons. The septum is unlike that of any species of *Thelypodium* known, but it is similar to the typical septum of *Caulanthus*. The rather large stigma that becomes bilobed suggests the latter genus also. Yellow is a color not yet admitted to *Thelypodium* but is of common occurrence in *Caulanthus*. The range also would point to the probability that this plant was derived from *Caulanthus* rather than from the northwestern genus.

3. *C. inflatus* Wats. Proc. Am. Acad. 17: 364. 1882; Coville, Contr. U. S. Nat. Herb. 4: 62. 1893; Robinson in Gray, Syn. Fl. N. Am. 1^a: 172. 1895.

Streptanthus inflatus Greene, Fl. Franciscana, 257. 1891.

Annual, glabrous or sparingly hirsute near the base, sometimes glaucous: stem erect, usually unbranched, stout, becoming conspicuously inflated above the middle, hollow, 3–6 dm. high: all the leaves with auriculate or clasping bases, the lowermost narrowed above the basal lobes; cauline leaves ovate to oblong, mostly acute, entire, 3–7 cm. long: sepals purple in the bud, in anthesis white with purple tips, glabrous, nearly equal in length, dorso-ventral pair slightly saccate at the base, scarious-margined, acute, 8–10 mm. long; petals white, broadly linear, crisped near the apex, but little longer than the sepals; filaments stout, longer pairs coherent for more than half their lengths, shorter than or equalling the calyx; anthers broadly apiculate, about 3 mm. long: inflorescence racemose; pedicels stout, more or less villous, ascending, about 3 mm. long: pods rather stout, 6–10 cm. long, erect or ascending, subsessile; style very short or obsolete, stigma deeply 2-lobed: cotyledons obliquely accumbent, seed-coat mucilaginous when boiled.

Distribution: southern California. Type: *Lemmon* from the Mojave Desert.

Specimens examined:

California: Mojave Desert, *Davidson* (Univ. Calif. Herb.); Mojave Desert, May 25, 1882, *Pringle* (Mo. Bot. Gard. Herb.); Fremont's Peak, Mojave Desert, May 6, 1906, *Hall & Chandler 6862* (Univ. Calif. Herb.); Sunset, Kern County, April 20, 1902, *Heller 7724* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); Randsburg, Kern County, April 14, 1905, *Heller 7702* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); Mojave Station, March 15, 1889, *Hasse* (Mo. Bot. Gard. Herb.); Antelope Valley, 1895, *Davidson* (Univ. Calif. Herb.); near Rosamond, Antelope Valley, May 9-24, 1896, *Davy 2272* (Univ. Calif. Herb.); Lancaster, June, *Davidson* (Univ. Calif. Herb.); Bakersfield, April 4, 1893, *Eastwood* (Univ. Calif. Herb.); Zapato Chino Creek, March 25-26, 1893, *Brandeggee* (Univ. Calif. Herb.).

4. *C. glaucus* Wats. Proc. Am. Acad. 17: 364. 1882; Robinson in Gray, Syn. Fl. N. Am. 1¹: 173. 1895.

Duration of root unknown, plant glabrous and glaucous throughout; stem erect, simple or sparingly branched, frequently flexuous below, rather stout, 3-8 dm. high: radical leaves not certainly known; lowermost stem-leaves rather thick, entire or repand, blade ovate or broadly elliptical, obtuse, 3.5-7 cm. long, abruptly narrowed to a petiole 2-4 cm. long; upper stem-leaves reduced, narrowly lanceolate: sepals greenish or purplish, narrow, not saccate at the base, nearly equal, 8-10 mm. long, with a very narrow scarious margin; petals greenish, broadly linear, recurved at the apex, about 1.5 cm. long; filaments linear, slender, nearly equal, 5-7 mm. long, anthers barely apiculate, 4-5 mm. long; inflorescence racemose; pedicels slender, 7-15 mm. long, enlarged at the apex: pods widely divaricate, frequently arcuate, 6-8 cm. long, rather slender, sessile; style nearly obsolete, stigma enlarged, deeply 2-lobed: cotyledons obliquely accumbent in the seed.

Distribution: southwestern Nevada and adjacent California. Type: *Shockley* from Candelaria, Esmeralda County, Nevada.

Specimens examined:

Nevada: Tonopah, April 24, 1907, *Jones* (Mo. Bot. Gard. Herb.); Gold Mountain, May-Oct., 1898, *Purpus 5974* (Univ. Calif. Herb.); Candelaria, Esmeralda County, May, *Shockley 19*

(Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); *Candelaria*, June 22, 1882, *Jones 3775* (Mo. Bot. Gard. Herb.).

California: Bishop, Owen's Valley, May 15, 1897, *Jones* (Mo. Bot. Gard. Herb.); Silver Canyon, White Mountains, Inyo County, May 7, 1906, *Heller 8193* (Mo. Bot. Gard. Herb.).

5. *C. pilosus* Wats. Bot. King's Exp. 27. 1871; Brewer & Wats. Geol. Survey Calif. Bot. 1: 36. 1876; Coville, Contr. U. S. Nat. Herb. 4: 62. 1893; Robinson in Gray, Syn. Fl. N. Am. 1¹: 173. 1895; Howell, Fl. Northwest Am. 48. 1897.

Biennial or short-lived perennial, sparingly pilose to densely hirsute, especially near the base: radical- and lower stem-leaves similar, petioled, oblanceolate in outline, coarsely toothed or pinnatifid, acute or obtuse, 4–15 cm. long; upper cauline leaves reduced, sparingly pinnatifid to entire, narrowed to a slender base: sepals green or purplish, more or less densely pilose, scarious margined, 5–8 mm. long; petals apparently white or veined with purple, narrowly spatulate, crisped apex curved outwards, 7–10 mm. long; filaments slightly broader at the base, distinct, about as long as the sepals, anthers somewhat apiculate, about 5 mm. long; inflorescence racemose; pedicels ascending, 5–8 mm. long; pods ascending or widely divaricate, frequently arcuate, 6–13 cm. long, about 1.5 mm. in diameter, subsessile; style short, stigma conspicuously 2-lobed: position of cotyledons and radicle in the seed very variable, from completely incumbent to obliquely accumbent.

Distribution: southwestern Idaho, western Nevada, eastern Oregon, and eastern California. Type: *Watson 113* from the Truckee Valley, Nevada.

Specimens examined:

Idaho: Weiser, April 18, 1900, *Jones 6170* (Mo. Bot. Gard. Herb.); New Plymouth, May 21, 1910, *Macbride 88* (Mo. Bot. Gard. Herb.); Emmett, Canyon County, June 9, 1911, *Macbride 883* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.).

Nevada: Simpson's Valley, May 26, 1859, *H. Engelmann* (Mo. Bot. Gard. Herb.); *Candelaria*, *Shockley 5* (Univ. Calif. Herb.); *Candelaria*, June 22, 1882, *Jones 3777* (Mo. Bot. Gard. Herb.); Gold Mountain, May–Oct., 1898, *Purpus 5956* (Univ. Calif. Herb.).

Oregon: stony hillsides of Powder River near the mouth, June 3, 1901, *Cusick 2541* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.); hills near Malheur River, Malheur County, June 7,

1901, *Cusick 2546* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.).

California: Darwin, April 28, 1897, *Jones* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.); Darwin Valley, Inyo County, May 19, 1906, *Hall & Chandler 7100* (Univ. Calif. Herb.); south of Bishop, Inyo County, May 21, 1906, *Heller 8295* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.); Lone Pine Creek, Inyo County, May 27, 1906, *Hall & Chandler 7206* (Univ. Calif. Herb.).

6. *C. Hallii* Payson, n. sp.¹

Annual, sparingly hispid-hirsute on the leaves and pedicels: stem glabrous, somewhat glaucous, simple or paniculately branched above, hollow, with a tendency to become inflated, erect, 5–8 dm. high: cauline leaves 4–16 cm. long, irregularly and deeply laciniate-pinnatifid or dentate with few, coarse lobes: sepals apparently yellowish, hispid-hirsute, lanceolate, nearly similar and equal, not saccate, about 6 mm. long; petals probably yellow, narrowly spatulate, about 9 mm. long; filaments in three pairs as to length, distinct, linear, 4, 5, and 6 mm. long, anthers not apiculate, about 3 mm. long; nectar glands rather well developed: inflorescence lax, racemose; pedicels widely divergent, 6–18 mm. long: pods terete, subsessile, divaricate, glabrous, 7–11 cm. long, 1.5 mm. wide; style nearly obsolete to 2 mm. long, stigma deeply 2-lobed: cells of septum rectangular, short.

Distribution: San Jacinto Mountains, southern California.

Specimens examined:

California: Coyote Canyon at 5000 ft. alt., on El Toro Mountain, May 25, 1899, *H. M. Hall 1165* (Mo. Bot. Gard. Herb., TYPE); Coyote Canyon, Santa Rosa Mountain, May 17–June 1, 1901, *Hall 1902* (Univ. Calif. Herb.).

This species seems to be as distinct as any unit that has been proposed in this genus and should not be confused with any other species. The tendency to inflation of the stem is suggestive of *C. major* or *C. crassicaulis*. The specific description was drawn from a single and somewhat fragmentary specimen, and the measurements may be found not sufficiently inclusive for other

¹*Caulanthus Hallii* sp. nov., annuus; caule glabro glauco superne ramoso fistuloso, subinflato erecto 5–8 dm. alto; foliis caulinis 4–6 cm. longis hispidulis non amplexicaulibus laciniato-pinnatifidis, lobis disparibus paucis; sepalis subflavis similibus hispidis, petalis flavis spatulatis 9 mm. longis, filamentis distinctis 4, 5, et 6 mm. longis; inflorescentiis primo racemosis laxis, pedicellis patentibus 6–18 mm. longis; siliquis teretibus subsessilibus patulis glabris 7–11 cm. longis 1.5 mm. latis, stylo brevissimo, stigmate bilobo.—Collected in Coyote Canyon, on El Toro Mountain, California, May 25, 1899, by *H. M. Hall 1165* (Mo. Bot. Gard. Herb., TYPE).

representatives of this species. This plant is dedicated to the collector, my friend, *Dr. H. M. Hall*. It is perhaps most closely related to *C. pilosus* Wats.

7. *C. major* (Jones) Payson, n. comb.

C. crassicaulis (Torr.) Wats. var. *major* Jones, Proc. Calif. Acad. III. 5: 623. 1895.

C. procerus Rydb. Fl. Rocky Mountains, 364. 1917, not Wats.

Short-lived perennial, glabrous and glaucous throughout: stems erect, simple or sparingly branched, hollow, not at all, or rarely somewhat inflated, frequently several from the root, 4–9 dm. high: radical- and lower stem-leaves oblanceolate in outline, entire, lyrate or runcinate, 5–15 cm. long, narrowed to a slender petiole; upper stem-leaves linear to lanceolate, few, much reduced: sepals purple or yellowish tipped with purple, not saccate, nearly equal, 7–10 mm. long; petals purplish, broadly linear or with slightly dilated, crisped blade, 1.5–2 times as long as the sepals; filaments equalling or shorter than the sepals, anthers broadly apiculate, 3–4 mm. long: inflorescence racemose; pedicels very stout, ascending, 3–5 mm. long: pods sessile, erect or ascending, stout, 8–13 mm. long; style nearly obsolete, stigma shallowly 2-lobed.

Distribution: southern Utah, western Nevada, southern California. Type: *M. E. Jones 5685* from Bromide Pass, Henry Mountains, Utah.

Specimens examined:

Utah: Bromide Pass, Henry Mountains, July 27, 1894, *Jones 5685* (Mo. Bot. Gard. Herb., U. S. Nat. Herb., and Univ. Calif. Herb.); Bromide Pass, Henry Mountains, July 27, 1894, *Jones 5655* (Mo. Bot. Gard. Herb.); Mt. Ellen Park, Henry Mountains, July 25, 1894, *Jones 5684h* (U. S. Nat. Herb.).

Nevada: Santa Rosa Mountains, July 11, 1898, *Cusick 2026* (Univ. Calif. Herb., Mo. Bot. Gard. Herb., and U. S. Nat. Herb.); Wadsworth, June 16, 1897, *Jones* (Mo. Bot. Gard. Herb. and U. S. Nat. Herb.); Reno, July, 1886, *Brandegee* (Univ. Calif. Herb.); Hunter Creek Canyon, Washoe County, July 19, 1913, *Kennedy 3038* (Mo. Bot. Gard. Herb.).

California: Providence Mountains, May 30, 1902, *Brandegee* (Univ. Calif. Herb.); San Bernardino Mountains, above Cushenberry Springs, June, 1886, *S. B. & W. F. Parish 1492* (U. S. Nat. Herb. and Mo. Bot. Gard. Herb.); San Bernardino Mountains,

June 17, 1894, *Parish 3034* (U. S. Nat. Herb.); northern slope San Bernardino Mountains, June 15, 1895, *Parish 3777* (U. S. Nat. Herb. and Univ. Calif. Herb.); San Antonio Mountains, June 20-22, 1899, *Hall 1252* (Univ. Calif. Herb.).

8. *C. crassicaulis* (Torr.) Wats. Bot. King's Exp. 27. 1871; Coville, Contr. U. S. Nat. Herb. 4: 62. 1893; Jones, Zoe 3: 283. 1893; Robinson in Gray, Syn. Fl. N. Am. 1st: 173. 1895; Howell, Fl. Northwest Am. 48. 1897; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 210. 1909; Rydb. Fl. Rocky Mountains, 364. 1917.

Streptanthus crassicaulis Torr. Stansbury's Exp. 383 t. 1. 1852; Walp. Ann. 3: 192. 1857; Gray, Proc. Am. Acad. 6: 186. 1866.

Caulanthus senilis Heller, Muhlenbergia 8: 137. t. 16. 1913.

Short-lived perennial, leaves and stem glabrous and glaucous: stems erect, unbranched, stout, more or less inflated, hollow, 3-10 dm. high: radical leaves rosulate, the primary oblanceolate, subentire or sinuate-dentate, 3-5 cm. long; secondary radical- and lowermost stem-leaves deeply and irregularly lyrate or runcinate, 5-15 cm. long; upper stem-leaves few, nearly linear; sepals purplish, densely hirsute, not saccate at the base, nearly equal in length, scarious-margined, dorso-ventral pair narrower than the lateral, 10-15 mm. long; petals purplish or brownish (at least in dried material), broadly linear, channelled, curved outwards, 15-20 mm. long; filaments linear, tetradynamous, 6-9 mm. long, anthers broadly apiculate, about 5 mm. long; inflorescence racemose; pedicels very stout, 3-5 mm. long, ascending, more or less hirsute; pods erect or ascending, rather stout, 10-13 cm. long, subsessile; style nearly obsolete, stigma broadly 2-lobed, lobes nearly 1 mm. long.

Distribution: southwestern Wyoming, southern Idaho, Utah, Nevada. Type: *Stansbury* from "mountain side on the east shore of Salt Lake," Utah.

Specimens examined:

Idaho: Mrs. Foote's Mesa, June 19, 1892, *Mulford* (Mo. Bot. Gard. Herb.).

Utah: Richfield, June 5, 1875, *Ward 177* (Mo. Bot. Gard. Herb.); Price, June 20, 1898, *Stokes* (Univ. Calif. Herb.).

Nevada: Palisade, June 14, 1882, *Jones 3776* (Mo. Bot. Gard. Herb.); east of Carson Lake, June 3, 1859, *H. Engelmann 78* (Mo. Bot. Gard. Herb.); White Mountains near Sunland, Mineral County, June 25, 1912, *Heller 10506* (U. S. Nat. Herb.); Mil-

ler Mountain, Esmeralda County, June 6, 1882, *Shockley 252* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); Gold Mountain, May-Oct., 1898, *Purpus 5992* (Univ. Calif. Herb.); Good Springs, Clark County, May, 1915, *K. Brandegee* (Univ. Calif. Herb.); Furber, June 9, 1891, *Jones* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.).

California: Nelson Range, Inyo County, May 23, 1906, *Hall & Chandler 7160* (Univ. Calif. Herb.).

8a. Var. glaber Jones, *Zoe 4*: 266. 1893; Robinson in Gray, *Syn. Fl. N. Am. 1*¹: 173. 1895.

C. glaber Rydb. *Fl. Rocky Mountains*, 364. 1917.

As in the type except for the glabrous or nearly glabrous sepals and pedicels. Of this variety Prof. Jones says: "During the present year (1893) I have seen this occasionally in eastern Nevada along with the species. It is quite striking but passes into the type."

Distribution: southern Utah and eastern Nevada. Type: *Jones* from "summit near Sink Valley, S. Utah at 7000 ft. altitude."

Specimen examined:

Utah: "S. Utah," 1877, *Palmer 24* (U. S. Nat. Herb.).

From observation in the field Prof. M. E. Jones says of the species: "The four stamens are declined and closely pressed to the lower petals, and the two others are as tightly pressed to the upper petals." According to the same author this plant grows in "loose soil in alkaline valleys as well as in better drained localities with little alkali."

9. C. Cooperi (Wats.) Payson, n. comb.

Thelypodium Cooperi Wats. *Proc. Am. Acad. 12*: 246. 1877; Coville, *Contr. U. S. Nat. Herb. 4*: 62. 1893; Robinson in Gray, *Syn. Fl. N. Am. 1*¹: 174. 1895.

Guillenia Cooperi Greene, *Leaf. Bot. Obs. & Crit. 1*: 228. 1906.

Annual, glabrous or short and very sparingly pubescent, somewhat glaucous: stem slender, flexuous or even serpentine, simple or branched above the base, 2-6 dm. long; the lowermost stem-leaves oblong to oblanceolate, narrowed to a broad petiole, entire or sinuate-lobed, obtuse, 2-6 cm. long; other stem-leaves sagittate, mostly entire, acute: sepals usually greenish, nearly equal, 6-7 mm. long, scarcely saccate; petals pale yellow, linear-

spatulate, 2-3 mm. longer than the sepals; filaments linear, about 4 mm. long, anthers about 2 mm. long; inflorescence lax, racemose; pedicels stout, recurved, 1-3 mm. long; pods deflexed, terete, glabrous or short-pubescent, 2-4.5 cm. long, sessile; style 1-2 mm. long, stigma small, shortly 2-lobed: cotyledons oblique with respect to the radicle in the seed.

Distribution: southern Nevada, western Arizona, and southern California. Type: *Cooper* from "near Ft. Mojave," California.

Specimens examined:

Arizona: Chloride, April 15, 1903, *Jones* (Mo. Bot. Gard. Herb.).

Nevada: Muddy Range, April 10, 1905, *Goodding 2226* (Rky. Mt. Herb.).

California: Shepherd's Canyon, May 1, 1897, *Jones* (Mo. Bot. Gard. Herb.); near Laws, Inyo County, May 5, 1906, *Heller 8184* (Mo. Bot. Gard. Herb.); Nelson Range, near Lee Well, Inyo County, May 23, 1906, *Hall & Chandler 7131* (Univ. Calif. Herb.); Pleasant Canyon, Panamint Mountains, May 10, 1906, *Hall & Chandler 6942* (Univ. Calif. Herb.); Randsburg, Kern County, April 14, 1905, *Heller 7680* (Mo. Bot. Gard. Herb.); San Felipe, San Diego County, April 16, 1895, *Brandegee* (Univ. Calif. Herb.); Cottonwood Mountains, Colorado Desert, May 11, 1905, *Hall 6023* (Univ. Calif. Herb.); Colorado Desert, April, 1905, *Brandegee* (Univ. Calif. Herb.); southwestern part of Colorado Desert, April, 1887, *Orcutt* (Mo. Bot. Gard. Herb.).

When Dr. Greene placed this species in his genus *Guillenia* he recognized its affinity to *C. lasiophyllus* and its allies. He did, however, suggest that it might be a generic monotype. Considering Greene's concept of the limited amount of divergence to be allowed within a genus, his suggestion seems quite pertinent and quite in accord with the present author's views. *C. Cooperi* is somewhat intermediate between the *lasiophyllus* group (*Guillenia*) and the *Coulteri* group. Were each group thought worthy of generic rank then *C. Cooperi* would become, perhaps, a monotypic genus connecting them. To the author's mind the existence of this intermediate species argues against such a possible generic segregation.

Thelypodium deserti Jones (Contr. to Western Botany 12: 1. 1908) is unknown to the author, but to judge from the description is apparently to be associated with *C. Cooperi*. That it is not specifically identical with it there seems no doubt. This

plant was collected by M. E. Jones in the Amargosa Desert of southwestern Nevada and is described as follows: "A weak and erect annual, much branched and stems tortuous but not climbing; racemes long and loose; lowest leaves 1-3 inches long with simple and linear lobes and petioled, the rest linear and entire; the whole plant except the very base is a loose inflorescence with straggling racemes; flowers minute, purplish-white, 1 line long, calyx ashy and equalled by the slender and indifferently spreading pedicel which in fruit elongates to 2 lines long; pods 6-9 lines long, acute at each end, arcuate, torulose, 1-2 lines wide, apex very blunt; whole plant nearly smooth. This has undoubtedly been mistaken for *Streptanthus longirostris*."

10. *C. simulans* Payson, n. sp.¹

Annual, densely short-hirsute below, sparingly so above, more or less glaucous: stem much branched from near the base and upwards, 3-4 dm. high (in specimens seen): radical leaves unknown; lower cauline leaves oblong, ovate or lanceolate, sparsely short-hirsute, especially on the margins and the midrib, sessile, sagittate at the base, subentire or sinuate-dentate, 2-4 cm. long; upper cauline leaves usually acute, entire or subentire, somewhat reduced: sepals yellowish, neither pair at all saccate, 5-6 mm. long, dorso-ventral pair narrower and slightly longer, sparsely hirsute; petals whitish, broadly linear or narrowly spatulate, somewhat crisped, 8-10 mm. long; filaments tetradynamous, linear, sparsely hirsute, 3.5-4.5 mm. long, anthers not apiculate, about 2 mm. long; inflorescence racemose; pedicels hirsute, somewhat recurved, 3-5 mm. long, rather stout: pods straight, divaricate-descending, terete, sessile, glabrous, 4-6.5 cm. long; style less than 1 mm. long, stigma definitely 2-lobed; septum thin, cells rectangular: seeds not winged, oblong, cotyledons usually obliquely accumbent, rarely completely accumbent.

Distribution: southern California.

Specimens examined:

¹*Caulanthus simulans* sp. nov., annuus plus minusve glaucus; caule ramoso inferne hirsutulo gracile 3-4 dm. alto; foliis caulinis oblongis ovatis vel lanceolatis hirsutulis sessilibus amplexicaulibus subintegris vel integris 2-4 cm. longis; sepalis subflavis non saccatis, fere similibus 5-6 mm. longis pilosiusculis, petalis pallidis linearibus spatulatisve 8-10 mm. longis, filamentis tetradynamis 3.5-4.5 mm. longis; inflorescentiis floriferis laxis racemosis, pedicellis hirsutis recurvulis 3-5 mm. longis; siliquis patento-reflexis rectis teretibus sessilibus glabris 4-6.5 cm. longis, stylo circiter 0.5 mm. longo, stigmate bilobo; seminibus immarginatis, cotyledonibus oblique incumbenibus.—Collected in Coyote Canyon, El Toro Mountain, California, May 17-June 1, 1901, H. M. Hall 1894 (Univ. Calif. Herb., TYPE).

California: Coyote Canyon, El Toro Mountain, 5500 ft. alt., May 17–June 1, 1901, *H. M. Hall 1894* (Univ. Calif. Herb., TYPE); summit Nigger Jim Hill, Cahuilla, May 17–June 1, 1901, *Hall* (Univ. Calif. Herb.); El Toro Mountain, May, 1899, *Hall 1171* (Univ. Calif. Herb.); vicinity of Winchester, April, 1902, *Hall 2908* in part (Mo. Bot. Gard. Herb.); between Elsinore and Menifee, March, 1893, *King* (Univ. Calif. Herb.).

C. simulans finds its closest allies in *C. Cooperi*, *C. Coulteri*, and *C. heterophyllus*. From the first it is at once separable by the longer pods and conspicuous hirsute pubescence. From the last two the quite terete pods and yellowish flowers distinguish it. The stigma in the new species is not so deeply 2-lobed as in *C. Coulteri*. In general appearance the present species is quite similar to *Caulanthus lasiophyllus* and on that account has received its specific name.

Doubtfully referred here is a specimen collected by *Miss Eastwood* from Painted Cave Ranch, Santa Barbara, California, April 25, 1908, No. 35 (Univ. Calif. Herb.). This has quite large, light yellow flowers and sinuate-lobed, narrowly oblong, cauline leaves, 5–16 mm. long. A depauperate plant on the same sheet has much smaller flowers and leaves. Further collections may prove this distinct or increase our present notion of the plant's variability.

11. *C. Coulteri* Wats. Bot. King's Exp. 27. 1871; Robinson in Gray, Syn. Fl. N. Am. 1': 172. 1895.

Streptanthus heterophyllus Gray, Proc. Am. Acad. 6: 185. 1866, in part.

S. Coulteri Gray in Wats. Bot. King's Exp. 19. 1871; Greene, Fl. Franciscana, 257. 1891.

Annual, more or less densely hirsute-pubescent, especially toward the base of the stem: stem erect, simple or sparingly branched, 3–7 dm. high: cauline leaves from broadly linear to oblong or oblanceolate, 4–8 cm. long, all but the lowermost amplexicaul at the base, sinuate-dentate; the upper lanceolate, subentire: sepals purple in the bud, becoming lighter or yellowish in anthesis, glabrous or hirsute, apparently very unequal in the bud, scarcely saccate, 7–15 mm. long; petals light, conspicuously veined with purple, broadly linear, crisped, much longer than the sepals; stamens in three pairs, ventral pair longest, about equalling the sepals, filaments united for about half or three-fourths their lengths, anthers 1–2 mm. long, filaments of dorsal pair somewhat shorter, free, anthers longer, filaments of solitary

stamens shortest, anthers longest: inflorescence rather lax, racemose; pedicels hirsute, reflexed, 5–10 mm. long: pods divergent-descending to pendent (rarely erect), glabrous, stout, subterete or slightly flattened, 5–10 cm. long, sessile or nearly so; style about 1 mm. long, stigma deeply 2-lobed.

Distribution: southern California. Type: *Coulter* from southern California.

Specimens examined:

California: above Pollasky, Madera County, April 11, 1906, *Heller 8135* (Mo. Bot. Gard. Herb.); Kaweah River Basin, March 31, 1902, *Hopping 270* (Univ. Calif. Herb.); hillsides near Springville, April–Sept., 1897, *Purpus 5065* (Mo. Bot. Gard. Herb.); Greenhorn Range, Kern County, June 2–10, 1904, *Hall & Babcock 5079* (Univ. Calif. Herb.); Kern Canyon, Kern County, April 26, 1905, *Heller 7768* (Mo. Bot. Gard. Herb.); hills near Caliente, Kern County, April 26–May 30, 1896, *Davy 1880* (Univ. Calif. Herb.); near Oil City, Kern County, April 8, 1905, *Heller 7630* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.); San Emidio, Kern County, March 26, 1895, *Eastwood* (Univ. Calif. Herb.); Elizabeth Lake, Los Angeles County, May 1–3, 1902, *Hall 3060* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.); Leonis Valley, Los Angeles County, May 9–24, 1896, *Davy 2636* and *2634* (Univ. Calif. Herb.).

Heller's specimen No. 7630 from near Oil City is unique among those seen in that the pods are erect. The stem is also more nearly glabrous than is usual for *C. Coulteri*. In these characters it approaches *C. Lemmonii* but the stigma is less deeply lobed than in that species. The insertion of *C. Coulteri* among the erect-podded species in the key is made because of this specimen.

12. *C. Lemmonii* Wats. Proc. Am. Acad. 23: 261. 1888; Robinson in Gray, Syn. Fl. N. Am. 1st: 172. 1895.

Streptanthus Parryi Greene, Fl. Franciscana, 257. 1891.

Annual, pilose on the lower leaves and towards the base of the stem, otherwise glabrous and glaucous: stem erect, simple or branched above the base, 2–8 dm. high: leaves sessile, auriculate-clasping at the base; lowermost oblanceolate or oblong, dentate, denticulate or entire, 2–10 cm. long; upper entire, sagittate, acute, smaller: calyx dark purple in the bud, fading to flesh color in anthesis, unequal, 7–15 mm. long; petals well exerted, crisped, white with dark purple veins; stamens in three pairs similar to those of *C. Coulteri*: inflorescence racemose; pedicels

frequently hispid, at length 10–20 mm. long, ascending in the bud, reflexed in anthesis and curved sharply upwards in fruit; pods sessile, erect, glabrous, subterete or slightly compressed, 8–13 cm. long, 2–3 mm. wide; style rarely over 1 mm. long; stigma large, lobes 1.5–3 mm. long; cells of the septum rectangular, short; seeds not winged.

Distribution: western California in the counties of Monterey and San Luis Obispo. Type: *J. G. & S. A. Lemmon* from "near Cholame, northeastern part of San Luis Obispo County."

Specimens examined:

California: 1888, *Parry* (Mo. Bot. Gard. Herb.); Paso Robles, April 9, 1899, *Barber* (U. S. Nat. Herb.); Paso Robles, Nov. 7, 1899, *Barber* (Univ. Calif. Herb.); Paso Robles, May 1, 1903, *Grant 146a* (Univ. Calif. Herb.).

13. *C. heterophyllus* (Nutt.) Payson, n. comb.

Streptanthus heterophyllus Nutt. in Torr. & Gray, Fl. N. Am. 1: 77. 1838; Walp. Rep. 1: 129. 1842; Dietr. Syn. Pl. 3: 730. 1843; Gray, Proc. Am. Acad. 6: 185. 1866, in part; Wats. Bot. King's Exp. 430. 1871; Greene, Fl. Franciscana, 257. 1891; Wats. in Gray, Syn. Fl. N. Am. 1¹: 169. 1895; Abrams, Fl. of Los Angeles and Vicinity, 167. 1904, and ed. 2, 152. 1917.

Annual, more or less hirsute-pubescent, especially towards the base: stem erect, simple or sparingly branched, 3–10 dm. high: leaves broadly linear or linear-lanceolate, pinnatifid with divaricate lobes, sinuate-dentate or subentire, all but the lowermost sagittate at the base, 3–12 cm. long: sepals purple, linear-lanceolate, not saccate, nearly equal, about 9 mm. long; petals pale with purple veining, linear, recurved, 12–14 mm. long; filaments linear, nearly equal, distinct, about 4.5 mm. long, anthers 3 mm. long, not apiculate: inflorescence lax, racemose; pedicels recurved or refracted, hirsute, 4–8 mm. long: pods pendent, straight, somewhat compressed, glabrous, 5–8 cm. long, 1.5–2 mm. wide, sessile; style about 2 mm. long, stigma shallowly 2-lobed: seeds narrowly winged, cotyledons oblique.

Distribution: southern California. Type: *Nuttall* from "St. Diego, upper California."

Specimens examined:

California: Soledad, March 28, 1882, *Jones 3129* (Mo. Bot. Gard. Herb.); Soledad, 1882, *Parry* (Mo. Bot. Gard. Herb.); hillside, Los Angeles County, April, 1890, *Hasse* (Mo. Bot. Gard. Herb.); Del Mar Heights, March 24, 1895, *Angier 79* (Mo. Bot.

Gard. Herb.); sand bluffs of the sea-shore, San Diego County, April 25, 1882, *Pringle* (Mo. Bot. Gard. Herb.); Rose Canyon, La Jolla, March 6, 1914, *Clements & Clements* 30 (Mo. Bot. Gard. Herb.); San Diego, 1882, *Parry* (Mo. Bot. Gard. Herb.); Encanto, 1882, *Parry* (Mo. Bot. Gard. Herb.); San Diego, April 25, 1903, *Brandegee* 3390 (Mo. Bot. Gard. Herb.); lower hills, San Bernardino Mountains, March and April, 1888, *S. B. & W. F. Parish* (Mo. Bot. Gard. Herb.).

Although carried for many years as a species of *Streptanthus* this plant has frequently been confused with other plants now considered members of the genus *Caulanthus*. *C. Coulteri*, for instance, was first segregated from material identified at one time by Dr. Gray as *S. heterophyllus*. In one place (Proc. Am. Acad. 6: 186) he remarks on the difference in the stigmas of these two plants but allows that much intraspecific variation. In the 'Flora Franciscana' Dr. Greene associates this plant with *Streptanthus Coulteri* and *S. Parryi* (*C. Lemmonii*). Both of those plants have been retained in *Caulanthus* for many years. The present plant, *C. heterophyllus*, has previously been retained in *Streptanthus* for two main reasons: it has pods that are somewhat compressed and seeds that are narrowly margined. This is taken to mean that *C. heterophyllus* shows a parallel development to what occurs in *Streptanthus*. From a phylogenetic standpoint it is out of place in *Streptanthus*, since it is undoubtedly derived from existing species of *Caulanthus*—or a species very similar to existing ones—and not from the same point that it is believed *Streptanthus* has developed.

14. *C. californicus* (Wats.) Payson, n. comb.

Stanfordia californica Wats. Geol. Survey Calif. Bot. 2: 479. 1880; Prantl in Engler & Prantl, Nat. Pflanzenfam. III. Abt. 2: 206. 1891; Robinson in Gray, Syn. Fl. N. Am. 1^a: 171. 1895; Hayek, Beih. Bot. Centralbl. 27^a: 314. 1911.

Streptanthus californicus Greene, Fl. Franciscana, 256. 1891.

Annual, glabrous or very sparingly pilose near the base: stem erect, branched from near the base and upwards, 2–4 dm. high: radical leaves oblanceolate, sinuately lobed to pinnatifid, obtuse, 3–6 cm. long; cauline leaves ovate to oblong, amplexicaul, shallowly dentate, obtuse: sepals purple-tipped, unequal, membranous and saccate near the base, 7–9 mm. long; petals whitish, little longer than the sepals, claw dilated, blade small, crisped; filaments 5–9 mm. long, longer pair sometimes slightly united

at the base, anthers 2-3 mm. long, apiculate: inflorescence lax, racemose; pedicels pilose, curved, ascending or somewhat deflexed, 5-10 mm. long: pods ascending or deflexed, straight, 2-4 cm. long, 2-3 mm. wide, slightly compressed or quadrangular, sessile; style 2-7 mm. long, stigma deeply 2-lobed: cotyledons in seed obliquely incumbent, 3-parted.

Distribution: south central California. Type: *Mrs. Bush* from "near Tulare."

Specimen examined:

California: Delano, May, 1888, *Eisen* (Mo. Bot. Gard. Herb.).

Stanfordia as a genus is practically dependent upon one character: the deeply trifid cotyledons, which are remarkable and without parallel in the genus *Caulanthus*. No tendency in this direction has ever been noticed in any of the other species. In other respects, however, *C. californicus* is a true *Caulanthus*. Only in very minor ways does it differ from its nearest relative, *C. Coulteri*. The pods are much shorter but their variable position from erect to deflexed is very suggestive of this group. The stamens are sometimes united at the base as in *C. Coulteri*. The sepals are more definitely inflated and the petals differently shaped, but these differences are no greater than between other species of *Caulanthus*. The habit and general appearance of the plant are so similar to its relatives in the present genus that an examination of the cotyledons would be necessary definitely to locate it for any one not perfectly familiar with the species. The author does not believe that one character is enough upon which to base a genus, particularly a monotypic genus, unless there is some reason to question its point of origin. This plant undoubtedly arose from *C. Coulteri* or a close relative of it, and so for the sake of simplicity the genus *Stanfordia* is merged in *Caulanthus*.

15. *C. stenocarpus* Payson, n. sp.¹

Annual, more or less densely hirsute-pubescent with flattened trichomes: stem erect, slender, simple or sparingly branched,

¹*Caulanthus stenocarpus* sp. nov., annuus plus minusve hirsuto-pubescent; caule erecto gracile ramuloso 3-4 dm. alto; foliis caulinis lineare-lanceolatis subintegris sessilibus amplexicaulibus 1-2 cm. longis; floribus pendentibus, sepalis non saecatis similibus circiter 4 mm. longis, petalis purpureis late linearibus 6 mm. longis, filamentis distinctis 3-4 mm. longis; inflorescentiis seris laxis racemosis, pedicellis recurvis hirsutis 1-2 mm. longis; siliquis teretibus rectis patento-reflexis glabris aut hispidulis, stylo 1-2 mm. longo, stigmate parvo subintegro; seminibus immarginatis, cotyledonibus oblique incumbentibus.—Collected on dry hillsides near Bernardo, California, May 1, 1903, *LeRoy Abrams 3364* (Mo. Bot. Gard. Herb., TYPE).

3-4 dm. high: cauline leaves few, the uppermost linear-lanceolate, subentire, sagittate at the base, 1-2 cm. long: flowers pendent; sepals purple, linear-lanceolate, not saccate, nearly equal, glabrous or nearly so, about 4 mm. long; petals at least veined with purple, broadly linear, about 6 mm. long; filaments distinct, about 3 mm. long, anthers not apiculate, about 1 mm. long: inflorescence lax, racemose; pedicels recurved, 1-2 mm. long, hirsute: pods divaricate-descending or pendent, straight, terete or slightly quadrangular, 2-4.5 cm. long, 1 mm. or less wide, sparsely retrose-pubescent with flattened trichomes, or glabrous, sessile; septum dense, cell-walls tortuous, closely compacted; style 1-2 mm. long, slightly tapering from base to apex, stigma small, nearly entire: seeds not winged, embryo purple, cotyledons obliquely incumbent.

Distribution: San Diego County, southern California.

Specimen examined:

California: dry hillside near Bernardo, May 1, 1903, *Abrams 3364* (Mo. Bot. Gard. Herb., TYPE).

This species is known from but a single specimen which has only one fragmentary flower and a few leaves. The fruits, however, are well developed and quite mature. It is to be expected that the measurements given in the specific description, especially of the floral parts, will probably not be found sufficiently inclusive for the entire specific variation. The type was distributed as *Streptanthus heterophyllus* but the new species is very different from that by virtue of the short, terete pods. Its closest ally is perhaps *C. simulans*. From this it differs markedly by the small, entire stigma and the dense septum. The character of this septum is quite different from any other species of *Caulanthus* except *C. lasiophyllus*.

16. *Caulanthus flavescens* (Hook.) Payson, n. comb.

Streptanthus flavescens Hook. *Icones* 1: t. 44. 1837; Torr. & Gray, *Fl. N. Am.* 1: 77. 1838; Hook. & Arn. *Bot. Beechey's Voy.* 322. 1841; Walp. *Rep.* 1: 129. 1842; Dietr. *Syn. Pl.* 3: 730. 1843; Torr. *Pac. Rail. Rept.* 4: 65. 1856; Gray, *Proc. Am. Acad.* 6: 186. 1866, in part; Wats. *Bot. King's Exp.* 430. 1871.

S. procerus Brewer, *Proc. Am. Acad.* 6: 519. 1866.

Thelypodium flavescens Wats. *Bot. King's Exp.* 25. 1871, not Jepson; Brewer & Wats. *Geol. Survey Calif. Bot.* 1: 38. 1876; Greene, *Fl. Franciscana*, 263. 1891; Robinson in Gray, *Syn. Fl. N. Am.* 1¹: 177. 1895.

Caulanthus procerus Wats. Bot. King's Exp. 27. 1871; Robinson in Gray, Syn. Fl. N. Am. 1¹: 173. 1895.

Thelypodium Hookeri Greene, Fl. Franciscana, 263. 1891; Robinson in Gray, Syn. Fl. N. Am. 1¹: 177. 1895.

T. Greenei Jepson, Fl. West. Mid. Calif. 212. 1901, and ed. 2, 181. 1911.

T. flavescens Jepson, Fl. West. Mid. Calif. 212. 1901, and ed. 2, 181. 1911.

Guillenla flavescens Greene, Leaf. Bot. Obs. & Crit. 1: 228. 1906.

G. Hookeri Greene, Leaf. Bot. Obs. & Crit. 1: 228. 1906.

Annual, rather stout, glabrous and glaucous or sparsely hirsute: stems erect, simple or branching in the inflorescence, 3-12 dm. high: radical leaves petioled, blade lanceolate to oblanceolate in outline, sinuate-pinnatifid, lyrate or coarsely lacinate, 5-22 cm. long; cauline leaves sessile, shortly petioled or even slightly auriculate at the base, deeply toothed to subentire: sepals pale yellow, lanceolate, acute or acuminate, 7-11 mm. long, glabrous; petals light yellow, 9-15 mm. long, claw rather broad, blade narrow, crisped, recurved, acute or acuminate: stamens included, anthers 2.5-4 mm. long, apiculate: inflorescence rather lax, racemose from the first; pedicels rather stout, curved upwards, 5-7 mm. long: pods erect, terete or somewhat 4-angled, glabrous or sparsely hirsute, subsessile, 4-8.5 cm. long, rather stout; style tapering to the apex, 2-3.5 mm. long, stigma entire or slightly 2-lobed: seeds not winged, cotyledons usually incumbent with tip of radical more or less oblique, rarely obliquely accumbent.

Distribution: west-central California in the vicinity of San Francisco. Type: *Douglas* from Monterey.

Specimens examined:

California: May 4, 1907, *K. Brandegee* (Univ. Calif. Herb.); Collinsville, Solano County, May 30, 1893, *K. Brandegee* (Univ. Calif. Herb.); Antioch, *Brandegee* (Univ. Calif. Herb.); Byron Springs, Contra Costa County, March 14, 1914, *Eastwood 3813* (U. S. Nat. Herb.); Livermore, *Michener & Bioletti* (Univ. Calif. Herb.).

There seems no way of separating specifically the type of this species collected by Douglas at Monterey and the plant described by Watson from Benecia. Greene (Fl. Franciscana) first called attention to the generic similarity of the two plants and remarked: " . . . they are with difficulty held distinct

as species. The only difference is in the petals; and by these the present plant would stand well in *Streptanthus* if its habit and narrow, terete pods were not those of the annual *Thelypods* precisely." Jepson followed Greene in his interpretation of the specific limits involved. The characters used by Greene and Jepson to keep the species apart, namely relative length of the sepals and petals and glabrous or hirsute pods, will not serve since there seems to be no correlation between them. Nor do these characters correlate with leaf texture and outline. In like manner the author can find no distinguishing characteristics upon which to separate *Caulanthus procerus*.

17. *C. anceps* Payson, n. name.

Thelypodium Lemmoni Greene, West. Am. Scientist 3: 156. 1887; Greene, Fl. Franciscana, 263. 1891; Robinson in Gray, Syn. Fl. N. Am. 1st: 178. 1895, not *Caulanthus Lemmoni* Wats.

Annual, glabrous and glaucous or sparsely pilose near the base: stems erect, simple or sparingly branched upwards, often stout, 6-18 dm. high: radical and lower stem-leaves narrowed to a short petiole, somewhat lanceolate in general outline, sinuate-dentate, often deeply lobed near the base, 6-15 cm. long; upper leaves sessile or nearly so, narrowly lanceolate, denticulate or subentire: sepals spreading, purple, with scarious margins, oblong, obtuse, glabrous, 3-4 mm. long, the outer pair slightly exceeding the inner; petals whitish, oblanceolate, obtuse, 4-5 mm. long; filaments linear, 2.5-3 mm. long, anthers about 1.5 mm. long, not apiculate; nectar glands very small: inflorescence shortly racemose, lax, elongating at maturity; pedicels slender, at first horizontal, later either reflexed or ascending, 5-6 mm. long: pods erect or pendent, terete, glabrous or sparsely hirsute, subsessile, 3-5 cm. long; style tapering to the apex, 2-3 mm. long, stigma small, slightly 2-lobed, lobes extending over the placentae.

Distribution: western California. Type: *Mr. & Mrs. J. G. Lemmon* from Lemmon's Ranch in the mountains of San Luis Obispo County.

Specimens examined:

California: Zapato Chino Creek, March 27, 1893, *Brandege* (Univ. Calif. Herb.); Estrella Plains, San Luis Obispo County, March 24, 1901, *Barber A7* (Univ. Calif. Herb.).

18. *C. lasiophyllus* (Hook. & Arn.) Payson, n. comb.

Turritis (?) *lasiophylla* Hook. & Arn. Bot. Beechey's Voy. 321. 1841; Walp. Rep. 1: 130. 1842; Dietr. Syn. Pl. 3: 689. 1843.

Sisymbrium reflexum Nutt. Proc. Acad. Phila. 4: 25. 1850; Brewer & Wats. Geol. Survey Calif. Bot. 1: 41. 1876.

S. deflexum Harvey mss. in Torr. Pac. Rail. Rept. 4: 66. 1857; Fournier, Recherches Crucifer. & Sisymbrium, 108. 1865; Gray, Proc. Am. Acad. 8: 377. 1873.

S. deflexum Harvey var. *xerophilum* Fournier, Recherches Crucifer. & Sisymbrium, 108. 1865.

Erysimum retrofractum Torr. U. S. Expl. Exp. 17: 230. 1874.

Thelypodium neglectum Jones, Am. Nat. 17: 875. 1882, in part; Greene, Bull. Torr. Bot. Club 13: 143. 1886.

T. lasiophyllum Greene, Bull. Torr. Bot. Club 13: 142. 1886; Greene, Fl. Franciscana, 264. 1891; Robinson in Gray, Syn. Fl. N. Am. 1: 177. 1895; Jepson, Fl. West. Mid. Calif. 212. 1901, and ed. 2, 180. 1911; Abrams, Fl. Los Angeles and Vicinity, 166. 1904, and ed. 2, 151. 1917; Piper, Contr. U. S. Nat. Herb. 11: 298. 1906; Frye & Rigg, Northwest Fl. 179. 1912.

Sisymbrium lasiophyllum K. Brandege, Zoe 2: 339. 1892.

Guillenia lasiophylla Greene, Leaf. Bot. Obs. & Crit. 1: 227. 1906.

Thelypodium lasiophyllum forma *xerophilum* Thell. Mitt. Bot. Mus. Zurich 83: 735. 1919.

Annual, more or less hirsute with simple or forked hairs, rarely nearly glabrous: stems erect, simple or branching above, 3-20 dm. high: leaves petioled, the lower oblanceolate or oblong, 3-15 cm. long, irregularly pinnatifid with divaricate, obtuse or acute segments which in turn are frequently toothed, upper leaves sinuate-toothed or entire, reduced: sepals oblong, about one half as long as the petals; petals white or light yellow, narrowly spatulate, about 6 mm. long; filaments linear, shorter than the petals, anthers 1-1.5 mm. long, not apiculate: inflorescence corymbose, rapidly elongating at maturity, pedicels 2-4 mm. long, at first ascending, in age usually becoming strongly recurved: pods reflexed, terete, linear, sessile or subsessile, straight or somewhat curved, 3-6 cm. long; style about 1 mm. long, stigma small, circular: seeds often apiculate, cotyledons usually more or less oblique.

Distribution: western Washington, Oregon, and California; Lower California. Type: *Douglas* from California.

Specimens examined:

Washington: sandy beach of Bellingham Bay, July 8, 1890, *Suksdorf 953* (Mo. Bot. Gard. Herb.).

Oregon: 1871, *Elihu Hall 36* (Mo. Bot. Gard. Herb.).

California: Kneeland Prairie, Humboldt County, May 1, 1918, *Tracy 4907* (Univ. Calif. Herb.); east of Alder Springs, Glenn County, May 27, 1914, *Heller 11448* (Mo. Bot. Gard. Herb. and Clokey Herb.); College City, Colusa County, 1905, *King* (Univ. Calif. Herb.); hills about Scotts Valley, Lake County, May 28–June 2, 1902, *Tracy 1730* (Univ. Calif. Herb.); Howell Mountain, Napa County, May 16, 1902, *Tracy 1500½, 1501* (Univ. Calif. Herb.); Mt. St. Helena, Napa County, April 20, 1903, *Baker 2629* (Mo. Bot. Gard. Herb.); Bethany, San Joaquin County, April 27, 1903, *Baker 2791* (Mo. Bot. Gard. Herb.); Martinez, Contra Costa County, April 24, 1862, *Brewer 987* (Mo. Bot. Gard. Herb.); Mt. Diablo, March 10, 1869, *Kellogg & Harford 55* (Mo. Bot. Gard. Herb.); Berkeley, 1891, *Blasdale* (Univ. Calif. Herb.); cultivated at Berkeley, April, 1894, *Davy* (Univ. Calif. Herb.); Briones Valley, region of San Francisco Bay, March 24, 1900, *Hall 579* (Univ. Calif. Herb.); Stanford University, April, 1900, *Elmer 2350* (Mo. Bot. Gard. Herb.); Crystal Springs Lake, San Mateo County, April 6, 1902, *Baker 459* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.); Red Mountain, Santa Clara County, May, 1903, *Elmer 4340* (Mo. Bot. Gard. Herb.); back of Alum Rock Park, Santa Clara County, April 27, 1907, *Heller 8474* (Mo. Bot. Gard. Herb.); sea-side, Monterey, May 29, 1912, *Eastwood 147* (Clokey Herb.); Carmel River, Monterey County, April 16, 1903, *Heller 6586* (Mo. Bot. Gard. Herb.); Paso Robles, March 26, 1899, *Barber* (Univ. Calif. Herb.); Arroyo Grande, March, 1895, *King* (Univ. Calif. Herb.); Mojave, March 24, 1890, *Fritchey* (Mo. Bot. Gard. Herb.); Santa Barbara, May, 1902, *Elmer 3882* (Mo. Bot. Gard. Herb.); Painted Cave Ranch, near Santa Barbara, April 25, 1908, *Eastwood 35* (Mo. Bot. Gard. Herb.); Antelope Valley, 1895, *Davidson* (Univ. Calif. Herb.); Sierra Santa Monica, May, 1891, *Hasse* (Mo. Bot. Gard. Herb.); Elysian Park, Los Angeles, March 13, 1901, *Setchell* (Univ. Calif. Herb.); Playa del Rey, April, 1903, *Hall 3771* (Univ. Calif. Herb.); Garvanza, March, 1903, *Grant 1288* (Rky. Mt. Herb.); Hesperia, April 10, 1892, *Trelease* (Mo. Bot. Gard. Herb.); Hemet, Feb. 6, 1897, *Hall 358* (Univ. Calif. Herb.); vicinity of Riverside, April, 1902, *Hall 2967* (Univ. Calif. Herb.); vicinity of Winchester, April, 1902, *Hall 2759* (Univ. Calif. Herb.); Gavilan, March 20, 1897, *Hall 405* (Univ. Calif. Herb.); Los Coyotes, western borders of Colorado Desert, April, 1902, *Hall 2823* (Univ. Calif. Herb.); San Diego, March 17, 1882, *Jones*

2634 (Mo. Bot. Gard. Herb. and Clokey Herb.); San Diego, Feb. 26, 1884, *Orcutt 1024* (Mo. Bot. Gard. Herb.); San Diego, April 1, 1895, *Brandegee* (Univ. Calif. Herb.); Sweetwater Dam, near San Diego, April, 1902, *Grant 1305* (Univ. Calif. Herb.); Del Mar, March 22, 1895, *Angier 196* (Mo. Bot. Gard. Herb.); Howard Canyon, La Jolla, April 14, 1914, *Clements & Clements 29* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); dry hillsides near Campo, May 24, 1903, *Abrams 3573* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); Avalon, Santa Catalina Island, April, 1895, *Trask* (Mo. Bot. Gard. Herb.); Sheep Island, April 15, 1893, *Tidestrom* (Univ. Calif. Herb.).

Mexico:

Lower California: Valley of Palms, April 15, 1882, *Jones* (Mo. Bot. Gard. Herb. and Clokey Herb.); Palm Valley, April 1, 1886, *Orcutt* (Mo. Bot. Gard. Herb.); San Luis, April 18, 1889, *Brandegee* (Univ. Calif. Herb.); Cedros Island, April 2, 1897, *Brandegee* (Univ. Calif. Herb.); Natividad, April 10, 1897, *Brandegee* (Univ. Calif. Herb.); Guadalupe Island, March 10, 1897, *Brandegee* (Univ. Calif. Herb.); Guadalupe Island, 1875, *E. Palmer 4* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); San Gregorio, Feb. 2, 1889, *Brandegee* (Univ. Calif. Herb.); San Julio, April 20, 1889, *Brandegee* (Univ. Calif. Herb.).

18a. *Var. inalienus* (Robinson) Payson, n. comb.

Thelypodium lasiophyllum (Hook. & Arn.) Greene var. *inalienum* Robinson in Gray, Syn. Fl. N. Am. 1st: 177. 1895; Abrams, Fl. Los Angeles and Vicinity, 166. 1904, and ed. 2, 151. 1917.

Sisymbrium acutangulum Brewer & Wats. Geol. Survey Calif. Bot. 1: 41. 1876, not DC.

S. acuticarpum Jones, Am. Nat. 17: 875. 1882.

Guillenia inaliena Greene, Leaflet Bot. Obs. & Crit. 1: 228. 1906.

Sparingly hirsute or nearly glabrous; pods erect or ascending, slender.

Distribution: with the species, but particularly abundant in the region near San Francisco Bay.

Specimens examined:

California: Vacaville, 1891, *Jepson* (Univ. Calif. Herb.); hills 3 miles south of Antioch, April 17, 1908, *Heller 8907* (Mo. Bot. Gard. Herb.); Brentwood, May 5, 1893, *Eastwood* (Univ. Calif. Herb.); hills near Berkeley, March 17, 1900, *Tracy 5999* (Univ. Calif. Herb.); Berkeley Hills, May 17, 1904, *Tracy 2075* (Univ.

Calif. Herb.); vicinity of Berkeley, April 26, 1907, *Walker 570* (Univ. Calif. Herb.); Lake Merced, San Francisco, April 25, 1903, *Tracy 1780* (Univ. Calif. Herb.); near San Francisco, 1868-69, *Kellogg & Harford 54* (Mo. Bot. Gard. Herb.); Marine Hospital, San Francisco, April 10, 1904, *Hall 4811* (Univ. Calif. Herb.); cliffs west of Colma, March 15, 1901, *Chandler 807* (Univ. Calif. Herb.); Stanford Univ., March, 1901, *Abrams 1147* (Mo. Bot. Gard. Herb.); Gigling Station east of Del Monte, May 11, 1903, *Heller 6709* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); coast hills, San Luis Obispo County, May, 1884, *Summers* (Univ. Calif. Herb. and Rky. Mt. Herb.); San Luis Obispo, June, 1886, *Summers* (Univ. Calif. Herb.); San Luis Mountain, April, 1886, *Summers* (Univ. Calif. Herb.); Santa Maria, March 8, 1886, *Summers* (Univ. Calif. Herb., Mo. Bot. Gard. Herb., and Rky. Mt. Herb.); White Sulphur Springs, April, 1895, *Sonne* (Univ. Calif. Herb.).

18b. Var. *rigidus* (Greene) Payson, n. comb.

Thelypodium rigidum Greene, *Pittonia* 1: 62. 1887; *Fl. Franciscana*, 264. 1891.

T. lasiophyllum (Hook. & Arn.) Greene var. *rigidum* Robinson in Gray, *Syn. Fl. N. Am.* 1¹: 177. 1895.

Guillenia rigida Greene, *Leaf. Bot. Obs. & Crit.* 1: 228. 1906.

Rather stout and very rigid, 3-10 dm. high, glabrous above: pods ascending, straight or curved outwards, stout; on very short pedicels.

Distribution: north central California.

Specimens examined:

California: 4 miles east of Williams, Colusa County, April 12, 1917, *Ferris 504* (Univ. Calif. Herb. and Mo. Bot. Gard. Herb.); Collinsville, May 30, 1893, *Brandeggee* (Univ. Calif. Herb.); Livermore, 1892, *Bioletti* (Univ. Calif. Herb.).

18c. Var. *utahensis* (Rydb.) Payson, n. comb.

Sisymbrium deflexum Gray, *Bot. Ives' Rept.* 6. 1860, not Harvey.

Thelypodium lasiophyllum Robinson in Gray, *Syn. Fl. N. Am.* 1¹: 177. 1895, in part.

T. utahense Rydb. *Bull. Torr. Bot. Club* 29: 233. 1902; Rydb. *Fl. Colo.* 167. 1906; Rydb. *Fl. Rocky Mountains*, 367. 1917.

Glabrous or nearly so: leaves usually thin, more or less membranous, lobes usually rounded and obtuse: pods reflexed, usu-

ally curved outwards.

Distribution: western Colorado (fide Rydberg), southern Utah, and Nevada, Arizona, southeastern California.

Specimens examined:

Utah: "southern Utah, northern Arizona, etc.," 1877, *E. Palmer* 28 (Mo. Bot. Gard. Herb.); St. George, April 9, 1880, *Jones* 1648 (Mo. Bot. Gard. Herb.); waste grounds, St. Thomas, May 3, 1902, *Goodding* 700 (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.).

Arizona: Williams Fork, March, 1876, *E. Palmer* 21 (Mo. Bot. Gard. Herb.); Santa Rosa to Casa Grande, March 13–April 23, 1903, *Griffiths* 4029 (Mo. Bot. Gard. Herb.); Tucson Mountains, March 13–April 23, 1903, *Griffiths* 3485 (Mo. Bot. Gard. Herb.); near Dudleyville, March 13–April 23, 1903, *Griffiths* 3712 (Mo. Bot. Gard. Herb.); Tucson, 1911, *Beard* (Mo. Bot. Gard. Herb.).

Nevada: Lincoln County, 1880, *Davis* 52 (Mo. Bot. Gard. Herb.); Moapa, April 8, 1905, *Goodding* 2191 (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.).

California: near Mojave, April 24, 1905, *Heller* 7751 (Mo. Bot. Gard. Herb.); plains east of Kern, April 6, 1905, *Heller* 7605 (Mo. Bot. Gard. Herb.); Adelanto, Mojave Desert, April 30, 1918, *Parish* 11797 (Mo. Bot. Gard. Herb.); Coyote Canyon in western borders of the Colorado Desert, April, 1902, *Hall* 2786 (Univ. Calif. Herb.).

The present subspecific treatment of *C. lasiophyllus* is not to be regarded as particularly discriminative and is intended only to indicate the broad groups within specific limits which are somewhat localized geographically. It is not supposed that these "varieties" are homogeneous within themselves. They could doubtless be broken up into a number of "forms" or "races." It is doubtful, however, if much could be done in the way of further segregation in the herbarium alone and perhaps the study is one for the geneticist rather than for the taxonomist.

To emphasize the localized racial diversity of this species the following quotation is made from Dr. Greene's 'Flora Franciscana': "The common form at San Francisco is small, early flowering, and has suberect pods. In the coast range the plant is often a yard high or more, late flowering, with pods straight and strongly deflexed. On the plains east of the Mount Diablo Range grows in great abundance a plant here referred which differs in being glabrous, with pods more or less curved, often spreading only, sometimes deflexed. All these need further examination;

and *T. neglectum* may prove to be one of them." A field and garden study of this species would seem to offer a most attractive subject for investigation for the student of the region to which it is native.

It is of further interest to note that *C. lasiophyllus* is adventive in Europe. Thellung reports it from Birsfelden (Switzerland) and from Rotterdam. So far as is known this is the only member of this group of genera to become a weed. This is particularly striking because its nearest relatives are extremely restricted in their range.

Co-type material of *T. neglectum* has been examined at the Gray Herbarium. It is a mixture of *Thelypodium laciniatum* and *Caulanthus lasiophyllus*. This material was collected by M. E. Jones at Santa Cruz, California in 1881. *Sisymbrium acuticarpum* seems to belong here also. Material collected by Prof. Jones from near the type locality and labelled in his own handwriting as "*Sisymbrium* n. sp." does not differ from typical forms of the species to any considerable extent. In the type the pods were described as erect, in the material seen they are reflexed.

Two specimens at hand from Catalina Island indicate that the form there is not typical. Further collections may show it variationally distinct.

All material from interior states is more or less similar in leaf texture and lobing and has accordingly been separated as a geographical variety. It evidently intergrades frequently with the coastal plant and may not be kept specifically distinct.

STREPTANTHELLA

STREPTANTHELLA Rydb. Fl. Rocky Mountains, 364. 1917.

Glabrous, annual herbs with entire or shallowly dentate leaves and branched stems. Flowers relatively small; sepals, particularly the lateral pair, saccate at the base; petals with narrow blades; stamens distinct, anthers short, apiculate. Pods pendent on recurved pedicels, sessile, strongly compressed, narrowed at the apex to a conspicuous beak that simulates a persistent style; valves dehiscent at the base but remaining attached at the apex; septum cells at the margin somewhat elongated at right angles to the replum, in the middle elongated parallel to the replum, all more or less tortuous. Seeds flattened, narrowly winged, cotyledons oblique. Generic type: *S. longirostris* (Wats.) Rydb.

1. *S. longirostris* (Wats.) Rydb. Fl. Rocky Mountains, 364. 1917.

Arabis longirostris Wats. Bot. King's Exp. 17. t. 1. 1871; Brewer & Wats. Geol. Survey Calif. Bot. 1: 31. 1876.

Streptanthus longirostris Wats. Proc. Am. Acad. 25: 125. 1889; Wats. in Gray, Syn. Fl. N. Am. 1st: 170. 1895; Howell, Fl. Northwest Am. 47. 1897; Piper, Contr. U. S. Nat. Herb. 11: 296. 1906; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 211. 1909; Frye & Rigg, Northwest Fl. 180. 1912.

Euklisia longirostris Rydb. Bull. Torr. Bot. Club 33: 142. 1906; Rydb. Fl. Colo. 166. 1906; Wootton & Standley, Contr. U. S. Nat. Herb. 19: 269. 1915.

Guillenia rostrata Greene, Leaf. Bot. Obs. & Crit. 1: 228. 1906.

Annual, glabrous and glaucous throughout: stem usually much branched above, slender, 3–6 dm. high: leaves deciduous at maturity; lower cauline leaves narrowly oblanceolate, usually sinuate-dentate or repand, 2–5 cm. long; upper leaves linear-lanceolate to linear, mostly entire: sepals greenish or tipped with purple, the lateral pair saccate at the base, dorsal-ventral pair slightly so, all nearly equal, 3–6 mm. long; petals yellowish, linear-spatulate, exceeding the sepals by about one-fourth; filaments tetradynamous, linear, about as long as the sepals, anthers apiculate, about 1 mm. long; nectar glands well developed at base of solitary stamen: inflorescence lax, shortly racemose, elongating in fruit; pedicels soon becoming recurved, slender, 2–5 mm. long: pods pendent, strongly compressed, sessile, 3–6 cm. long, 1–2 mm. wide; style very short or obsolete, stigma nearly entire: seeds narrowly winged, flat.

Distribution: southwestern to central Wyoming, western Colorado, northern New Mexico, Utah, Arizona, Nevada, southeastern Washington, eastern Oregon, eastern and southern California, and northwestern Mexico. Type: *Watson 72* from "Steamboat Springs near Washoe City, about Humboldt Lake, Nevada."

Specimens examined:

Wyoming: Alcova, Natrona County, July 1, 1901, *Goodding 159* (Mo. Bot. Gard. Herb.); sandhills in Wind River Valley, May 19, 1860, *Hayden* (Mo. Bot. Gard. Herb.); Point of Rocks, June 1, 1897, *Nelson 3082* (Mo. Bot. Gard. Herb.).

Colorado: Grand Junction, May, 1891, *Eastwood* (Bethel Herb.); Grand Junction, May, 1892, *Eastwood* (Mo. Bot. Gard. Herb.); Naturita, May 7, 1914, *Payson 280* (Mo. Bot. Gard.

Herb.); Naturita, May 15, 1914, *Payson* 301 (Mo. Bot. Gard. Herb.).

New Mexico: Aztec, April, 1899, *Baker* 362 (Mo. Bot. Gard. Herb.).

Utah: Diamond Valley, May 19, 1902, *Goodding* 879 (Mo. Bot. Gard. Herb.); Green River, May 9, 1890, *Jones* (Mo. Bot. Gard. Herb.); near St. George, 1874, *Parry* 9 (Mo. Bot. Gard. Herb.).

Arizona: mesa, Yuma, 1911, *Beard* (Mo. Bot. Gard. Herb.).

Nevada: desert near Goshoot Mountains, May 8, 1859, *H. Engelmann* (Mo. Bot. Gard. Herb.); Lincoln County, 1880, *Davis* 46 (Mo. Bot. Gard. Herb.); Moapa, April 8, 1905, *Goodding* 2210 (Mo. Bot. Gard. Herb.); Las Vegas, May 8, 1905, *Goodding* 2324 (Mo. Bot. Gard. Herb.); Winnemucca Lake, June 3, 1913, *Kennedy* 1999 (Mo. Bot. Gard. Herb.); Truckee River sands, Wadsworth, June 6, 1913, *Kennedy* 2035 (Mo. Bot. Gard. Herb.).

Oregon: Umatilla, May 1, 1882, *Howell* (Mo. Bot. Gard. Herb.).

California: near Laws, May 5, 1906, *Heller* 8183 (Mo. Bot. Gard. Herb.); Darwin, April 28, 1897, *Jones* (Mo. Bot. Gard. Herb.); Lancaster, June, 1902, *Elmer* 3625 (Mo. Bot. Gard. Herb.).

WAREA

WAREA Nutt. Jour. Acad. Phila. 7: 83. 1834; Torr. & Gray, Fl. N. Am. 1: 98. 1838; Gray, Gen. Am. Bor.-Or. Ill. 1: 155. 1848; Benth. & Hook. Gen. Pl. 1: 80. 1862; Prantl in Engler & Prantl, Nat. Pflanzenfam. III, Abt. 2: 155. 1891; Robinson in Gray, Syn. Fl. N. Am. 1^a: 179. 1895; Small, Fl. Southeastern U. S. 487. 1903, and ed. 2, 487. 1913; Hayek, Beih. Bot. Centralbl. 27^a: 180. 1911.

Erect, annual, glabrous herbs with slender, branching stems. Leaves entire, amplexicaul, sessile or cuneate at the base, all similar and none rosulate at the base of the stem. Flowers reddish purple to white, clavate in the bud; sepals equal, broadly linear or spatulate, not saccate, widely spreading or reflexed in anthesis; petals unguiculate, claw slender, blade dilated; stamens nearly equal, filaments linear, exserted, anthers revolute when dry; ovary long-stipitate. Young inflorescence contracted and corymbiform, little elongated in fruit; pedicels slender, in age deciduous at the base from the axis of the inflorescence. Pods somewhat compressed parallel to the partition, linear, falcate,

conspicuously stipitate; style very short, stigma small, subentire, the lobes evidently produced over the placenta; septum thin, cells elongated parallel to the replum, walls straight or slightly tortuous, especially near the middle. Seeds not winged, cotyledons obliquely accumbent. Generic type: *W. amplexifolia* Nutt.

KEY TO THE SPECIES

- A. Leaves broad at the base, amplexicaul or sessile.
 - a. Leaves distinctly and deeply amplexicaul at the base ----- 1. *W. amplexifolia*
 - b. Leaves sessile or subamplexicaul ----- 2. *W. sessilifolia*
- B. Leaves cuneate or subpetioled at the base.
 - a. Stipe 8-11 mm. long; claws of petals papillose --- 3. *W. cuneifolia*
 - b. Stipe 3-6 mm. long; claws of petals fimbriate --- 4. *W. Carteri*

1. *W. amplexifolia* Nutt. Jour. Acad. Phila. 7: 83. 1834, in part; Torr. & Gray, Fl. N. Am. 1: 98. 1838; Dietr. Syn. Pl. 3: 717. 1843; Robinson in Gray, Syn. Fl. N. Am. 1st: 180. 1895, in part; Chapman, Fl. Southern U. S., ed. 3, 28. 1897, in part; Small, Fl. Southeastern U. S. 487. 1903, and ed. 2, 487. 1913.

Stanleya amplexifolia Nutt. Am. Jour. Sci. I. 5: 297. 1822; DC. Prodr. 1: 200. 1824; Spreng. Syst. 2: 909. 1825.

Glabrous and somewhat glaucous: stems simple or paniculately branched above, 4-8 dm. tall: leaves ovate to oblong, obtuse or acute, 1.5-4 cm. long, deeply amplexicaul at the base, basal lobes rounded: flowers purplish or white; petals 7-9 mm. long, blade suborbicular, about one-half as long as the slender, slightly papillose claw: mature inflorescence 1-4 cm. long; pedicels nearly horizontal, 10-15 mm. long, deciduous: pods, including stipe, 6-7.5 cm. long (according to Nuttall), linear, curved; stipe about 10 mm. long.

Distribution: eastern Florida. Type from "East Florida" by A. Ware.

Specimens examined:

Florida: Tavares, Sept. 15, 1895, *Webber 20* (Mo. Bot. Gard. Herb.); pine barrens, Haines City, Aug. 14, 1897, *Curtiss 5958* (U. S. Nat. Herb. and Mo. Bot. Gard. Herb.); Clarcona, Orange County, Nov. 5, 1899, *Meislahn 36* (U. S. Nat. Herb.).

2. *W. sessilifolia* Nash, Bull. Torr. Bot. Club 23: 101. 1896; Small, Fl. Southeastern U. S. 487. 1903, and ed. 2, 487. 1913.

W. amplexifolia Nutt. Jour. Acad. Phila. 7: 83. t. 10. 1834, as to illustration and habitat.

Very similar to the preceding species, more or less glaucous: stems simple or paniculately branched above, 2–6 dm. tall: leaves ovate or ovate-lanceolate, rather thick, obtuse or acute, sessile or very slightly auriculate at the base, 1–3.5 cm. long: flowers purple, sometimes apparently pale; petals about 10 mm. long, claw slightly papillose: mature inflorescence 1–3 cm. long; pedicels divaricate, about 1 cm. long, deciduous: pods, including stipe, 2–4 cm. long; stipe 11–14 mm. long.

Distribution: western Florida. Type from "pine lands at Bellair, about 4 miles south of Tallahassee, Leon County."

Specimens examined:

Florida: Bellair, Leon County, Sept. 3, 1895, *Nash 2544* (U. S. Nat. Herb., TYPE, and Mo. Bot. Gard. Herb.); sandy pine barrens, Bristol, Oct. 25, 1895, *Mohr* (U. S. Nat. Herb.); Santa Rosa Island, Sept., 1876, *Romer* (U. S. Nat. Herb.); Santa Rosa Island, Aug. 31, 1899, *S. M. Tracy 6428* (Mo. Bot. Gard. Herb. and U. S. Nat. Herb.).

This species, although quite distinct, has been confused with *W. amplexifolia* in the past. The illustration given by Nuttall (Jour. Acad. Phila.) to illustrate that species is evidently of *W. sessilifolia*. In this publication also the habitat is given as "West Florida." It would seem that Ware collected both species but the one originally described as *W. amplexifolia* was from east Florida and in it the leaves were truly amplexicaul. That plant then must retain the name because of priority of publication. However, the plant that Nuttall really had in mind when he described the genus *Warea* was that described by Nash as *W. sessilifolia*.

3. *W. cuneifolia* (Muhl.) Nutt. Jour. Acad. Phila. 7: 84. 1834; Torr. & Gray, Fl. N. Am. 1: 98. 1838; Gray, Gen. Am. Bor.-Or. Ill. 1: 155. t. 66. 1848; Robinson in Gray, Syn. Fl. N. Am. 1: 180. 1895, in part; Chapman, Fl. Southern U. S., ed. 3, 28. 1897, in part; Small, Fl. Southeastern U. S. 487. 1903, and ed. 2, 487. 1913, in part.

Cleome cuneifolia Muhl. Catalogue, 61. 1813, name only; Nutt. Gen. 2: 73. 1818; DC. Prodr. 1: 242. 1824; Elliott, Bot. South Carolina and Georgia 2: 150. 1824; Dietr. Syn. Pl. 2: 1068. 1840.

Stanleya gracilis DC. Syst. 2: 512. 1821; DC. Prodr. 1: 200. 1824; Spreng. Syst. 2: 909. 1825.

Stems paniculately branched above, slender, 4-8 dm. tall: leaves narrowly oblong to linear-oblongate, 1-4 cm. long, cuneate at the base, obtuse or retuse at the apex: sepals white or purplish, linear-oblongate, 4-5 mm. long; petals 6-8 mm. long, blade broadly obovate, somewhat shorter than the minutely papillose claw; filaments strongly exerted: mature inflorescence not over 1.5 cm. long, pedicels slender, divaricate, 3-10 mm. long, deciduous: pods, including stipe, 3-5.5 cm. long, linear, curved; stipe slender, 8-10 mm. long.

Distribution: South Carolina and Georgia. Type from Georgia.

Specimens examined:

South Carolina: Aiken, Sept. 12-15, 1909, *Eggleston 5066* (U. S. Nat. Herb. and Mo. Bot. Gard. Herb.).

Georgia: sand-hills north of Augusta, Aug. 12, 1884, *J. D. Smith* (Mo. Bot. Gard. Herb.); sand-hills of Gum Swamp Creek, Montgomery County, Sept. 10, 1903, *Harper 1981* (U. S. Nat. Herb. and Mo. Bot. Gard. Herb.); sand-hills of Satilla River, Pierce County, Aug. 1, 1902, *Harper 1465* (Mo. Bot. Gard. Herb. and U. S. Nat. Herb.).

Nuttall in the first description of this species gives the habitat as follows: "on sandy barren grassy ridges in the southern parts of Georgia, Alabama and west Florida." In Muhlenberg's 'Catalogue,' however, where the name is published for the first time, the habitat is given as "Georgia." This would seem sufficient to identify *W. cuneifolia* as the northern plant rather than the species now known as *W. Carteri* although the original description might apply to either.

4. *W. Carteri* Small, Bull. Torr. Bot. Club 36: 159. 1909; Small, Fl. Southeastern U. S. 1337. 1913.

W. cuneifolia Robinson in Gray, Syn. Fl. N. Am. 1^a: 180. 1895, in part; Chapman, Fl. Southern U. S., ed. 3, 28. 1897, in part; Small, Fl. Southeastern U. S. 487. 1903, in part.

Very similar to the preceding in general appearance, 5-15 dm. tall: leaves narrowly oblong to linear-oblongate, cuneate at the base, obtuse and frequently apiculate at the apex: sepals about 5 mm. long; petals white or nearly so, somewhat longer than the sepals, blade ovate to suborbicular, crisped, about as long as the slender, minutely fringed claws: mature inflorescence 0.5-3 cm. long, pedicels slender, divergent, 3-10 mm. long: pods

linear, curved, 3-5 cm. long (including stipe); stipe slender, 3-6 mm. long; style very short, stigma subentire.

Distribution: southern and eastern Florida. Type from "pine-lands between Cutler and Black Point," collected by *Small & Carter 831*.

Specimens examined:

Florida: Miami, Nov., 1878, *Garber 26* (U. S. Nat. Herb. and Mo. Bot. Gard. Herb.); sand ridges between the ocean and Indian River, Sept., 1879, *Curtiss 171* (U. S. Nat. Herb.).

This species, according to Dr. Small, "occurs in great abundance, especially in southern peninsular Florida." It is closely related to *W. cuneifolia* and has been almost universally referred to that species in the past.

STANLEYELLA

STANLEYELLA Rydb. Bull. Torr. Bot. Club 34: 435. 1907.

Biennial glabrous herb with branching stem. Leaves entire or toothed, all narrowed at the base. Flowers white or pale purplish; sepals spreading or reflexed in anthesis, not saccate; petals short-clawed; filaments distinct, linear, folded in the bud, anthers more or less coiled at maturity. Pods terete, subsessile, or shortly stipitate; septum thin, cells more or less rectangular, not tortuous. Seeds not winged, cotyledons obliquely accumbent. Generic type: *S. Wrightii* (Gray) Rydb.

1. *S. Wrightii* (Gray) Rydb. Bull. Torr. Bot. Club 34: 435. 1907; Wootton & Standley, Contr. U. S. Nat. Herb. 19: 267. 1915; Rydb. Fl. Rocky Mountains, 368. 1917.

Thelypodium Wrightii Gray, Smithson. Contr. [Pl. Wright.] 3: 7. 1852, and 5: 12. 1853; Porter & Coulter, Syn. Fl. Colo. 9. 1874; Hemsley, Biol. Cent.-Am. Bot. 1: 31. 1879; Coulter, Manual Rocky Mountain Region, 21. 1885; Coulter, Contr. U. S. Nat. Herb. 1: 30. 1890, and 2: 15. 1891; Robinson in Gray, Syn. Fl. N. Am. 1^a: 177. 1895; Rydb. Fl. Colo. 167. 1906; Nelson in Coulter & Nelson, Manual Cent. Rocky Mountains, 209. 1909; Clements & Clements, Rocky Mountain Flowers, 28. 1914.

Biennial, glabrous throughout or sparingly pilose at the base: stem erect, branching, 6-15 dm. high: radical and lower stem-leaves irregularly lyrate, 1-1.5 dm. long; stem-leaves somewhat reduced upwards, irregularly toothed to subentire: sepals oblong

or broadly linear, about 5 mm. long; petals oblanceolate, short-clawed, exceeding the sepals at least one-half; filaments slightly tetradynamous, linear, 5-7 mm. long, folded in the bud, anthers about 2 mm. long, not apiculate; nectar glands well developed: inflorescence in flower corymbose, elongating in fruit; pedicels slender, horizontal or divaricate-descending, 5-10 mm. long: pods widely spreading, terete, torulose, stipe 0.5-2 mm. long; style rarely over 1 mm. long, stigma entire: seeds not winged; cotyledons obliquely incumbent or nearly accumbent.

Distribution: western Texas, southern and western Colorado, New Mexico, southern Utah and Nevada, Arizona and north-western Mexico. Type: *Wright*, pass of the Limpio, western Texas.

Specimens examined:

Colorado: Webster Canyon, July 25, 1872, *Redfield 418* (Mo. Bot. Gard. Herb.); Canyon City, 1871, *Brandegee 351* (Univ. Calif. Herb.); Trinidad, Sept. 26, 1913, *Rose & Fitch 17515* (Mo. Bot. Gard. Herb.); Trinidad, July 20, 1918, *Osterhout 5755* (Rky. Mt. Herb.); San Luis Valley, Sept., 1875, *Brandegee* (Mo. Bot. Gard. Herb.); Pitkin County, July 20-30, 1900, *Mann* (Mo. Bot. Gard. Herb.); Durango, July 18, 1898, *Baker, Earle & Tracy 510* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.).

New Mexico: White Mountains, Lincoln County, July 22, 1897, *Wooton 194* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.); Gray, Lincoln County, July 22, 1898, *Skehan 42* (Mo. Bot. Gard. Herb.); Gray, Lincoln County, July, 1900, *Earle & Earle 158* (Mo. Bot. Gard. Herb.); Organ Mountains, Oct. 18, 1903, *Wooton* (Rky. Mt. Herb.); Mogollon Mountains, Aug., 1881, *Rusby 26* (Mo. Bot. Gard. Herb.); Mogollon Mountains, Aug. 5, 1903, *Metcalfe 385* (Mo. Bot. Gard. Herb. and Rky. Mt. Herb.); Tularosa Creek, Sacramento Mountains, Aug. 20, 1899, *Wooton* (Mo. Bot. Gard. Herb.); on mountains at the Copper Mines, Aug., 1851, *Wright 845* (Mo. Bot. Gard. Herb.); near Silver City, July 18, 1880, *Greene* (Mo. Bot. Gard. Herb.).

Utah: Cane Spring Mountains, May-Oct. 1898, *Purpus 6231* (Rky. Mt. Herb. and Univ. Calif. Herb.).

Arizona: Prescott, Oct. 28, 1917, *Bethel* (Bethel Herb.); Prescott, Aug. 28, 1894, *Toumey* (Univ. Calif. Herb.); Pigeon Creek, Aug. 4, 1912, *Goodding 1276* (Rky. Mt. Herb.).

Nevada: Calientes, May 24, 1902, *Goodding 945* (Rky. Mt. Herb. and Mo. Bot. Gard. Herb.).

Mexico:

Lower California: Topo, Sept. 8, 1884, *Orcutt 945* (Mo. Bot. Gard. Herb. and Univ. Calif. Herb.).

1a. Var. *tenellum* (Jones) Payson, n. comb.

Thelypodium Wrightii Gray var. *tenellum* Jones, Proc. Calif. Acad. II. 5: 622. 1895.

Stems slender, leaves very thin, entire or with rounded lobes; inflorescence in fruit much elongated; pods very slender, torulose, 4-6 cm. long.

Distribution: Utah. Type: *M. E. Jones 5559* from Provo.

Specimens examined:

Utah: Provo Slate Canyon, July, 1894, *Jones 5559* (Mo. Bot. Gard. Herb., Rky. Mt. Herb., and Univ. Calif. Herb.).

LIST OF EXSICCATAE

In the following index to the specimens cited the collector's number, if one occurs, is printed in italics and is followed immediately by a number in parenthesis. The latter number indicates the serial number of the species involved as adopted in the present study. The name of this species follows the parenthesis. Generic abbreviations are as follows: C. (*Caulanthus*); Ch. (*Chlorocrambe*); Stan. (*Stanleyella*); Strep. (*Streptanthella*); T. (*Thelypodium*) and W. (*Warea*).

Abrams, LeRoy.

1147 (18a) C. *lasiophyllus* var. *inalienus*; *2699* (1) C. *amplexicaulis*;

3364 (15) C. *stenocarpus*; *3573* (18) C. *lasiophyllus*.

Angier, B. S.

79 (13) C. *heterophyllus*; *196* (18) C. *lasiophyllus*.

Austin, R. M.

(4) T. *Howellii*.

E. N. B.

(14a) T. *lilacinum* var. *subumbellatum*.

Baker, C. F.

362 (1) Strep. *longirostris*; *459* (18) C. *lasiophyllus*; *635* (14) T. *lilacinum*;

1020 (10b) T. *laciniatum* var. *milleflorum*; *1191* and *1218* (3) T. *crispum*;

2629, *2791* (18) C. *lasiophyllus*; (7) T. *sagittatum*.

Baker, C. F., Earle, F. S. & Tracy, S. M.

510 (1) Stan. *Wrightii*.

Baker, H. P.

(14) T. *lilacinum*.

Baker, M. S. & Nutting, F.

(3) T. *crispum*; (4) T. *Howellii*.

Barber, J. H.

47 (17) C. *anceps*; (18) C. *lasiophyllus*; (12) C. *Lemmonii*.

Beard, A.

(18c) C. *lasiophyllus* var. *utahensis*; (1) Strep. *longirostris*.

Bennitt, D.

- 39, 156 (10) *T. laciniatum*.
 Bethel, E.
 (1) Stan. Wrightii; (9) *T. flexuosum*; (11) *T. rhomboideum*.
 Bioletti, F. T.
 (18b) *C. lasiophyllus* var. *rigidus*.
 Blankinship, J. W.
 (14a) *T. lilacinum* var. *subumbellatum*.
 Blasdale, W. C.
 (18) *C. lasiophyllus*.
 Bolander, H. N.
 6272 (3) *T. crispum*.
 Brandegee, K.
 (8) *C. crassicaulis*; (16) *C. flavescens*.
 Brandegee, T. S.
 351 (1) Stan. Wrightii; 377 (10) *T. laciniatum*; 636 (12) *T. integrifolium*; 637 (10b) *T. laciniatum* var. *milleflorum*; 638 (4) *T. Howellii*; 821 (14) *T. lilacinum*; 3390 (13) *C. heterophyllus*; 4278 (11a) *T. rhomboideum* var. *gracilipes*; (16) *C. flavescens*; (7) *C. major*; (3) *C. inflatus*; (9) *C. Cooperi*; (17) *C. anceps*; (18) *C. lasiophyllus*; (18b) *C. lasiophyllus* var. *rigidus*; (1) Stan. Wrightii; (3) *T. crispum*.
 Brewer, W. H.
 987 (18) *C. lasiophyllus*.
 Brown, H. E.
 469 (2) *T. brachycarpum*.
 Burglehaus, F. H.
 (14a) *T. lilacinum* var. *subumbellatum*.
 Butler, G. D.
 1850 (2) *T. brachycarpum*.
 Carlton, E. C. & Garrett, A. O.
 6705 (14) *T. lilacinum*.
 Chandler, H. P.
 807 (18a) *C. lasiophyllus* var. *inalienus*.
 Chestnut & Drew.
 (3) *T. crispum*.
 Clements, F. E. & E. S.
 29 (18) *C. lasiophyllus*; 30 (13) *C. heterophyllus*.
 Clute, W. N.
 82 (11) *T. rhomboideum*.
 Cotton, J. S.
 391 (10b) *T. laciniatum* var. *milleflorum*; 874 (12) *T. integrifolium*.
 Crandall, C. S.
 (14) *T. lilacinum*.
 Curtiss, A. H.
 171 (4) *W. Carteri*; 5958 (1) *W. amplexifolia*.
 Cusick, W. C.
 1618 (4) *T. Howellii*; 1884 (9) *T. flexuosum*; 1955 (10b) *T. laciniatum* var. *milleflorum*; 2026 (7) *C. major*; 2292 (1) *Ch. hastata*; 2541, 2546 (5) *C. pilosus*; 2694 (12) *T. integrifolium*; 2735, 2812 (4) *T. Howellii*.
 Davidson, A. A.
 (3) *C. inflatus*; (18) *C. lasiophyllus*.
 Davis, P. W.
 46 (1) *Strep. longirostris*; 52 (18c) *C. lasiophyllus* var. *utahensis*.
 Davy, J. B.
 1880 (11) *C. Coulteri*; 2272 (3) *C. inflatus*; 2469, 2563 (1) *C. amplexicaulis*; 2634, 2636 (11) *C. Coulteri*; (18) *C. lasiophyllus*.
 Eastwood, A.
 35, in part (18) *C. lasiophyllus*; 35, in part (10) *C. simulans*; 147 (18) *C. lasiophyllus*; 3813 (16) *C. flavescens*; (11) *C. Coulteri*; (3) *C. inflatus*; (18a) *C. lasiophyllus* var. *inalienus*; (14) *T. lilacinum*; (1) *Strep. longirostris*.
 Earle, F. S. & Earle, E. S.
 158 (1) Stan. Wrightii.

Eggleston, W. W.

5066 (3) *W. cuneifolia*.

Eisen, G.

(14) *C. californicus*.

Elmer, A. D. E.

1073 (12) *T. integrifolium*; 2350 (18) *C. lasiophyllus*; 3625 (1) *Strep. longirostris*; 3882, 4340 (18) *C. lasiophyllus*.

Engelmann, G.

(2) *T. brachycarpum*; (14) *T. lilacinum*; (11) *T. rhomboideum*.

Engelmann, H.

77 (9) *T. flexuosum*; 78 (8) *C. crassicaulis*; 110 (14) *T. lilacinum*; 111 (11) *T. rhomboideum*; (5) *C. pilosus*; (1) *Strep. longirostris*; (10b) *T. laciniatum* var. *milleflorum*; (14) *T. lilacinum*.

Ferris, R. S.

504 (18b) *C. lasiophyllus* var. *rigidus*.

Fritchey.

(18) *C. lasiophyllus*.

Garber, A. P.

26 (4) *W. Carteri*.

Goodding, L. N.

159 (1) *Strep. longirostris*; 700 (18c) *C. lasiophyllus* var. *utahensis*; 879 (1) *Strep. longirostris*; 945 (1) *Stan. Wrightii*; 1085 (7) *T. sagittatum*; 1276 (1) *Stan. Wrightii*; 1466 (7) *T. sagittatum*; 1789 (11) *T. rhomboideum*; 2191 (18c) *C. lasiophyllus* var. *utahensis*; 2210 (1) *Strep. longirostris*; 2226 (9) *C. Cooperi*; 2324 (1) *Strep. longirostris*.

Grant, G. B.

146a (12) *C. Lemmonii*; 1288, 1305 (18) *C. lasiophyllus*.

Greene, E. L.

803 (10) *T. laciniatum*; 846 (2) *T. brachycarpum*; (1) *Stan. Wrightii*.

Griffiths, D.

3485, 3712, 4029 (18c) *C. lasiophyllus* var. *utahensis*; 4058 (2) *C. sulfureus*.

Hall, E.

34 (10) *T. laciniatum*; 36 (18) *C. lasiophyllus*.

Hall, E. & Harbour, J. P.

51 (14) *T. lilacinum*.

Hall, H. M.

358, 405, 579 (18) *C. lasiophyllus*; 918 (1) *C. amplexicaulis*; 1165 (6) *C. Hallii*; 1171 (10) *C. simulans*; 1252 (7) *C. major*; 1436 (1) *C. amplexicaulis*; 1894 (10) *C. simulans*; 1902 (6) *C. Hallii*; 2759 (18) *C. lasiophyllus*; 2786 (18c) *C. lasiophyllus* var. *utahensis*; 2823 (18) *C. lasiophyllus*; 2908, in part (10) *C. simulans*; 2967 (18) *C. lasiophyllus*; 3060 (11) *C. Coulteri*; 3101 (1) *C. amplexicaulis*; 3771 (18) *C. lasiophyllus*; 4811 (18a) *C. lasiophyllus* var. *inalienus*; 6023 (9) *C. Cooperi*; (10) *C. simulans*.

Hall, H. M. & Babcock, E. B.

4092 (2) *T. brachycarpum*; 5079 (11) *C. Coulteri*.

Hall, H. M. & Chandler, H. P.

6862 (3) *C. inflatus*; 6942 (9) *C. Cooperi*; 7100 (5) *C. pilosus*; 7131 (9) *C. Cooperi*; 7160 (8) *C. crassicaulis*; 7206 (5) *C. pilosus*; 7226 (10) *T. laciniatum*; 7284 (3) *T. crispum*.

Harper, R. M.

1465, 1981 (3) *W. cuneifolia*.

Hasse, H. E.

(13) *C. heterophyllus*; (3) *C. inflatus*; (18) *C. lasiophyllus*.

Hayden, F. V.

(1) *Strep. longirostris*; (14) *T. lilacinum*; (7a) *T. sagittatum* var. *crassicaarpum*.

Heller, A. A.

6526 (18) *C. lasiophyllus*; 6709 (18a) *C. lasiophyllus* var. *inalienus*; 7605 (18c) *C. lasiophyllus* var. *utahensis*; 7630 (11) *C. Coulteri*; 7680 (9) *C. Cooperi*; 7702, 7724 (3) *C. inflatus*; 7751 (18c) *C. lasiophyllus* var. *utahensis*; 7768 (11) *C. Coulteri*; 8011 (2) *T. brachycarpum*; 8135 (11) *C. Coulteri*; 8153 (1) *Strep. longirostris*; 8184 (9) *C. Cooperi*; 8193 (4) *C. glaucus*;

- 8262 (10) *T. laciniatum*; 8295 (5) *C. pilosus*; 8474 (18) *C. lasiophyllus*; 8907 (18a) *C. lasiophyllus* var. *inalienus*; 9953 (11) *T. rhomboideum*; 10506 (8) *C. crassicaulis*; 11448 (18) *C. lasiophyllus*.
- Heller, A. A. & Heller, E. G.
3022 (10) *T. laciniatum*.
- Heller, A. A. & Kennedy, P. B.
8671 (3) *T. crispum*.
- Henderson, L. F.
73 (10) *T. laciniatum*; 3248 (7) *T. sagittatum*.
- Hillman, F. H.
(11) *T. rhomboideum*.
- Hopping, R.
270 (11) *C. Coulteri*.
- Howell, J.
(10) *T. laciniatum*.
- Howell, T.
345 (1) *T. eucosum*; (1) *Strep. longirostris*.
- Jepson, W. L.
(13a) *C. lasiophyllus* var. *inalienus*.
- Johnston, E. L.
598 (14) *T. lilacinum*.
- Jones, M. E.
1358 (1) *Ch. hastata*; 1648 (18c) *C. lasiophyllus* var. *utahensis*; 2634 (18) *C. lasiophyllus*; 3129 (13) *C. heterophyllus*; 3767 (10) *T. laciniatum*; 3768 (7) *T. sagittatum*; 3769 (3) *T. crispum*; 3771 (9) *T. flexuosum*; 3772 (10b) *T. laciniatum* var. *milleflorum*; 3775 (4) *C. glaucus*; 3776 (8) *C. crassicaulis*; 3777 (5) *C. pilosus*; 5522 (14) *T. lilacinum*; 5559 (1a) *Stan. Wrightii* var. *tenella*; 5655, 5684h, 5685 (7) *C. major*; 6015e (5) *T. ovalifolium*; 6170 (5) *C. pilosus*; (9) *C. Cooperi*; (8) *C. crassicaulis*; (4) *C. glaucus*; (18) *C. lasiophyllus*; (7) *C. major*; (5) *C. pilosus*; (1) *Strep. longirostris*; (3) *T. crispum*; (10) *T. laciniatum*; (10b) *T. laciniatum* var. *milleflorum*; (10a) *T. laciniatum* var. *streptanthoides*; (14a) *T. lilacinum* var. *subumbellatum*; (11) *T. rhomboideum*.
- Jones, W. W.
(14a) *T. lilacinum* var. *subumbellatum*.
- Kellogg, A. & Harford, W. G. W.
54 (18a) *C. lasiophyllus* var. *inalienus*; 55 (18) *C. lasiophyllus*.
- Kelsey, F. D.
257 (14a) *T. lilacinum* var. *subumbellatum*.
- Kennedy, P. B.
1003, 1975 (10) *T. laciniatum*; 1999, 2035 (1) *Strep. longirostris*; 3038 (7) *C. major*.
- King, M. A.
(18) *C. lasiophyllus*; (10) *C. simulans*.
- Leiberg, J. B.
172 (10) *T. laciniatum*; 396 (9) *T. flexuosum*; 455 (4) *T. Howellii*; 817 (12) *T. integrifolium*; 2039 (9) *T. flexuosum*.
- Leidy, J.
(14) *T. lilacinum*.
- Lemmon, J. G.
12, 24 (3) *T. crispum*; 40 (10b) *T. laciniatum* var. *milleflorum*; (3) *T. crispum*.
- Leonard, F. E.
(7) *T. sagittatum*.
- Letterman, G. W.
13 (7a) *T. sagittatum* var. *crassicaule*.
- Lunell, J.
(10) *T. laciniatum*; (10a) *T. laciniatum* var. *streptanthoides*.
- Macbride, J. F.
88 (5) *C. pilosus*; 234, 796 (10b) *T. laciniatum* var. *milleflorum*; 883 (5) *C. pilosus*; 2569 (14) *T. lilacinum*.

- Macbride, J. F. & Payson, E. B.
 2982 (7) *T. sagittatum*; 3094 (10b) *T. laciniatum* var. *milleflorum*; 3560 (14) *T. lilacinum*.
- Mann, C.
 (1) *Stan. Wrightii*.
- Meislahn, M.
 36 (1) *W. amplexifolia*.
- Metcalfe, O. B.
 385 (1) *Stan. Wrightii*.
- Michener & Bioletti, F. T.
 (16) *C. flavescens*.
- Mohr, C.
 (2) *W. sessilifolia*.
- Mulford, A. I.
 (8) *C. crassicaulis*; (10b) *T. laciniatum* var. *milleflorum*; (14) *T. lilacinum*; (7) *T. sagittatum*.
- Nash, G. V.
 2544 (2) *W. sessilifolia*.
- Nelson, A.
 58 (7a) *T. sagittatum* var. *crassicaarpum*; 574, 747 (14) *T. lilacinum*; 922 (7a) *T. sagittatum* var. *crassicaarpum*; 1663 (14) *T. lilacinum*; 3013 (7) *T. sagittatum*; 3082 (1) *Strep. longirostris*; 4140 (14) *T. lilacinum*; 4545, 4673, 7164 (7) *T. sagittatum*; 7606 (14) *T. lilacinum*; (14) *T. lilacinum*.
- Nelson, A. & Macbride, J. F.
 1343 (10) *T. laciniatum*; 1346 (7) *T. sagittatum*; 1349 (14) *T. lilacinum*; 1380 (14a) *T. lilacinum* var. *subumbellatum*; 2085 (7) *T. sagittatum*.
- Nelson, A. & Nelson, E.
 5474 (7a) *T. sagittatum* var. *crassicaarpum*; 6034 (14a) *T. lilacinum* var. *subumbellatum*; 6663 (7a) *T. sagittatum* var. *crassicaarpum*.
- Nevius, R. D.
 (1) *T. eucosum*.
- Oleson, O. M.
 242 (14a) *T. lilacinum* var. *subumbellatum*.
- Orcutt, C. R.
 945 (1) *Stan. Wrightii*; 1024 (18) *C. lasiophyllus*; (9) *C. Cooperi*; (18) *C. lasiophyllus*.
- Osterhout, G. E.
 5755 (1) *Stan. Wrightii*; (14) *T. lilacinum*.
- Palmer, E.
 4 (18) *C. lasiophyllus*; 21 (18c) *C. lasiophyllus* var. *utahensis*; 22 (10) *T. rhomboideum*; 24 (8a) *C. crassicaulis* var. *glaber*; 25 (5) *T. ovalifolium*; 28 (18c) *C. lasiophyllus* var. *utahensis*; 225 (13) *T. affine*.
- Parish, S. B.
 1435 (13) *T. affine*; 1794 (8) *T. stenopetalum*; 2326 (1) *C. amplexicaulis*; 3034 (7) *C. major*; 3036 (1) *C. amplexicaulis*; 3777 (7) *C. major*; 3787 (8) *T. stenopetalum*; 10532 (13) *T. affine*; 11797 (18c) *C. lasiophyllus* var. *utahensis*; (1) *C. amplexicaulis*.
- Parish, S. B. & W. F.
 846 (1) *C. amplexicaulis*; 1485 (13) *T. affine*; 1492 (7) *C. major*; (13) *C. heterophyllus*.
- Parry, C. C.
 9 (1) *Strep. longirostris*; (13) *C. heterophyllus*; (12) *C. Lemmonii*; (13) *T. affine*; (14a) *T. lilacinum* var. *subumbellatum*.
- Payson, E. B.
 280, 301 (1) *Strep. longirostris*.
- Payson, E. B. & Payson, L. B.
 1728 (10b) *T. laciniatum* var. *milleflorum*.
- Piper, C. V.
 1473 (10a) *T. laciniatum* var. *streptanthoides*.
- Pringle, C. G.
 (13) *C. heterophyllus*; (3) *C. inflatus*.

- Purpus, C. A.
 5065 (11) *C. Coulteri*; 5956 (5) *C. pilosus*; 5974 (4) *C. glaucus*; 5992 (8) *C. crassicaulis*; 6231 (1) Stan. Wrightii.
- Ramaley, F. & Robbins, W. W.
 3627 (14) *T. lilacinum*.
- Redfield, J. H.
 418 (1) Stan. Wrightii.
- Romer.
 (2) *W. sessilifolia*.
- Rose, J. N. & Fitch, W. R.
 17515 (1) Stan. Wrightii.
- Rusby, H. H.
 26 (1) Stan. Wrightii.
- Rydberg, P. A. & Carlton, E. C.
 6926 (14) *T. lilacinum*.
- Rydberg, P. A. & Garrett, A. O.
 9429 (11a) *T. rhomboideum* var. *gracilipes*.
- Sandberg, J. H. & Leiberg, J. B.
 190 (10) *T. laciniatum*; 229 (10a) *T. laciniatum* var. *streptanthoides*.
- Savage, T. E., Cameron, J. E. & Lenocker, F. E.
 (10) *T. laciniatum*.
- Setchell, W. A.
 (18) *C. lasiophyllus*.
- Sharp, S. S.
 432 (14) *T. lilacinum*.
- Shockley, W. H.
 5 (5) *C. pilosus*; 19 (4) *C. glaucus*; 252 (8) *C. crassicaulis*.
- Skehan, J.
 42 (1) Stan. Wrightii.
- Smith, C. P.
 1529, 1640 (7) *T. sagittatum*; 2003 (14) *T. lilacinum*; 2121 (7) *T. sagittatum*.
- Smith, J. D.
 (3) *W. cuneifolia*.
- Sonne, C. F.
 337 (3) *T. crispum*; (16) *C. flavescens*; (18a) *C. lasiophyllus* var. *inalienus*; (3) *T. crispum*; (10b) *T. laciniatum* var. *milleflorum*.
- Stokes, S. G.
 (8) *C. crassicaulis*.
- Suksdorf, W. N.
 841 (10) *T. laciniatum*; 953 (18) *C. lasiophyllus*.
- Summers, Mrs. R. W.
 (18a) *C. lasiophyllus* var. *inalienus*.
- Tidestrom, I.
 (18) *C. lasiophyllus*.
- Torrey, J.
 14 (3) *T. crispum*.
- Toumey, J. W.
 (1) Stan. Wrightii.
- Tracy, J. P.
 599 (18a) *C. lasiophyllus* var. *inalienus*; 1500½, 1501, 1730 (18) *C. lasiophyllus*; 2075, 1780 (18a) *C. lasiophyllus* var. *inalienus*; 4907 (18) *C. lasiophyllus*.
- Tracy, S. M.
 6428 (2) *W. sessilifolia*.
- Trask, B.
 (18) *C. lasiophyllus*.
- Trelease, W.
 3991 (10) *T. laciniatum*; (18) *C. lasiophyllus*.
- Turesson, G.
 42 (10b) *T. laciniatum* var. *milleflorum*.

- Vasey, G.
 194 (7a) *T. sagittatum* var. *crassicaupum*; (14) *T. lilacinum*.
 Walker, E. P.
 369 (11a) *T. rhomboideum* var. *gracilipes*.
 Walker, H. A.
 570 (18a) *C. lasiophyllus* var. *inalienus*.
 Ward, L. F.
 177 (8) *C. crassicaulis*.
 Webber, H. J.
 20 (1) *W. amplexifolia*.
 Wootton, E. O.
 194 (1) *Stan. Wrightii*; (1) *Stan. Wrightii*.
 Wright, C.
 845 (1) *Stan. Wrightii*.
 Wright, W. G.
 (1) *C. amplexicaulis*.

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A NEW HYBRID NYMPHAEA

GEORGE H. PRING

Horticulturist to the Missouri Botanical Garden

During the past two seasons various experiments in breeding water-lilies have been undertaken at the Garden, especially with *Nymphaea* "Mrs. Edwards Whitaker" as a parent, with both interesting and disappointing results in the progeny.

The principal disappointment to the writer at first was the inability to obtain a "Whitaker" type with a viviparous leaf character, despite the fact of using viviparous parents, such as *N. daubeniana*, *N. "Mrs. Woodrow Wilson"* var. *gigantea*, and *N. "Panama Pacific,"* reciprocal crosses being made in each case with *N. "Mrs. Edwards Whitaker."* This unusual leaf character present in the later hybrids has originated from the species *N. micrantha*. The desirable factor with the viviparous hybrids is the ease with which the type is perpetuated through the young plantlets which grow upon the parent leaves. Propagation is accomplished when thinning out the leaves during the summer, the young plants being easily cut from the center of the leaves. They are then potted and transferred to the greenhouse tanks for the next season's display. With the non-viviparous hybrids the parent plants must be dug from the ponds in October or prior to frost and placed in the greenhouse tanks until they die down, when they are cleaned to ascertain whether or not young basal tubers have developed. The large-flowered forms of *N. "Mrs. Edwards Whitaker"* always develop extremely large parent tubers during the summer which ordinarily last but one season, and in most instances they lack the small tubers necessary for the next season. To keep up a stock of this lily it is therefore necessary to grow plants in pots during the summer for tuber development.

× NYMPHAEA "MRS. G. H. PRING," PRING, N. HYB.
(*N. ovalifolia* ♀ × *N. "Mrs. Edwards Whitaker"* ♂)

Up to the present time the only pure white tropical day-blooming water-lily in cultivation has been the small-flowered *Nymphaea flavo-virens (gracilis)* native of Mexico. It has been used to advantage in breeding, being the parent of such popular hybrids as *N. "Stella Gurney," "Mrs. C. W. Ward,"* and "*William Stone,*"

but when grown for floral display it is rather disappointing on account of the small size of the flowers. The writer therefore experimented with a view of obtaining a white lily comparable to the present-day horticultural forms. Stock of *N. "Mrs. Edwards Whitaker"* was selected as a desirable parent because its flowers frequently bleach to white with age and also because white forms resembling *N. ovalifolia* appear in the second generation.

During 1919 reciprocal crosses were made between *N. "Mrs. Edwards Whitaker"* and its parent *N. ovalifolia*. A number of seedlings were raised during the winter and planted in the ponds outside. *Nymphaea "Mrs. Edwards Whitaker"* ♀ × *ovalifolia* ♂ resulted in forms of the Whitaker type, while the reciprocal cross, *N. ovalifolia* ♂ × "Whitaker" ♀, showed *ovalifolia* or the white form as a dominant factor. One pure albino form possessing the large Whitaker-shaped flowers and leaf characters was selected as the desired type. It was carefully self-pollinated during the summer of 1920, the offspring producing albino flowers. In 1921 the finest flowers were again selected and self-pollinated, the seedlings again producing pure white flowers but with an improvement both in number and size of petals. By careful selection and self-pollination during the past season all pink and blue shades which dominated the parent flowers have been eliminated. The new hybrid produces plenty of fertile seeds, a factor not evident in most present-day hybrids.

Description.—Flowers white, 8–10 inches across, opening for 5–6 successive days from 7 A. M. to 6 P. M. during August, 3–5 opening at one time, extremely fragrant; bud narrowly ovate-acuminate, light green sparsely striped with irregular minute dark purple lines; peduncle terete, rising 1 foot above the water, in cross-section showing 7 main air-canals circled by 15–16 smaller ones; sepals 4-wedged, ovate-triangular, somewhat hooded at the apex, thick, fleshy in texture, outer surface light green, sparsely striped with irregular dark purple lines, inner surface white, greenish white at the base, showing 10–12 nerves; petals white, comprising 3 whorls, the outermost lanceolate, obtuse, 4 inches long, $\frac{3}{4}$ –1 inch wide, outer surface showing light green at the thickened base, 6–8-nerved, inner whorls pure white, innermost whorl smaller; stamens 120–130, canary-yellow, outer whorls white at the apex, 2 inches long, with appendages ovate-oblong at the base, linear above, inner whorls becoming shorter and narrower toward the innermost, which is linear; carpels 28–

30, with styles oblong, obtuse, introrse, yellow; fruit globose, well filled with fertile seeds; developed leaves narrowly peltate, ovate to suborbicular, 16 inches long by 14 inches wide, with sinuate margins becoming deeper at the base, almost entire at the apex; sinuses overlapping, terminating into acuminate lobes, green on the upper surface, faintly spotted with reddish brown, fading away as the leaves develop, the under surface light green flushed with pink; petioles light brown, measuring 6-8 feet when fully developed.

Var. marmorata.—Flowers same as type; leaves light green, irregularly blotched with reddish brown upon the upper surface. This marmoration is transfused from *Nymphaea* "Mrs. Edwards Whitaker."

EXPLANATION OF PLATE

PLATE 20

Showing parentage of *Nymphaea* "Mrs. G. H. Pring."

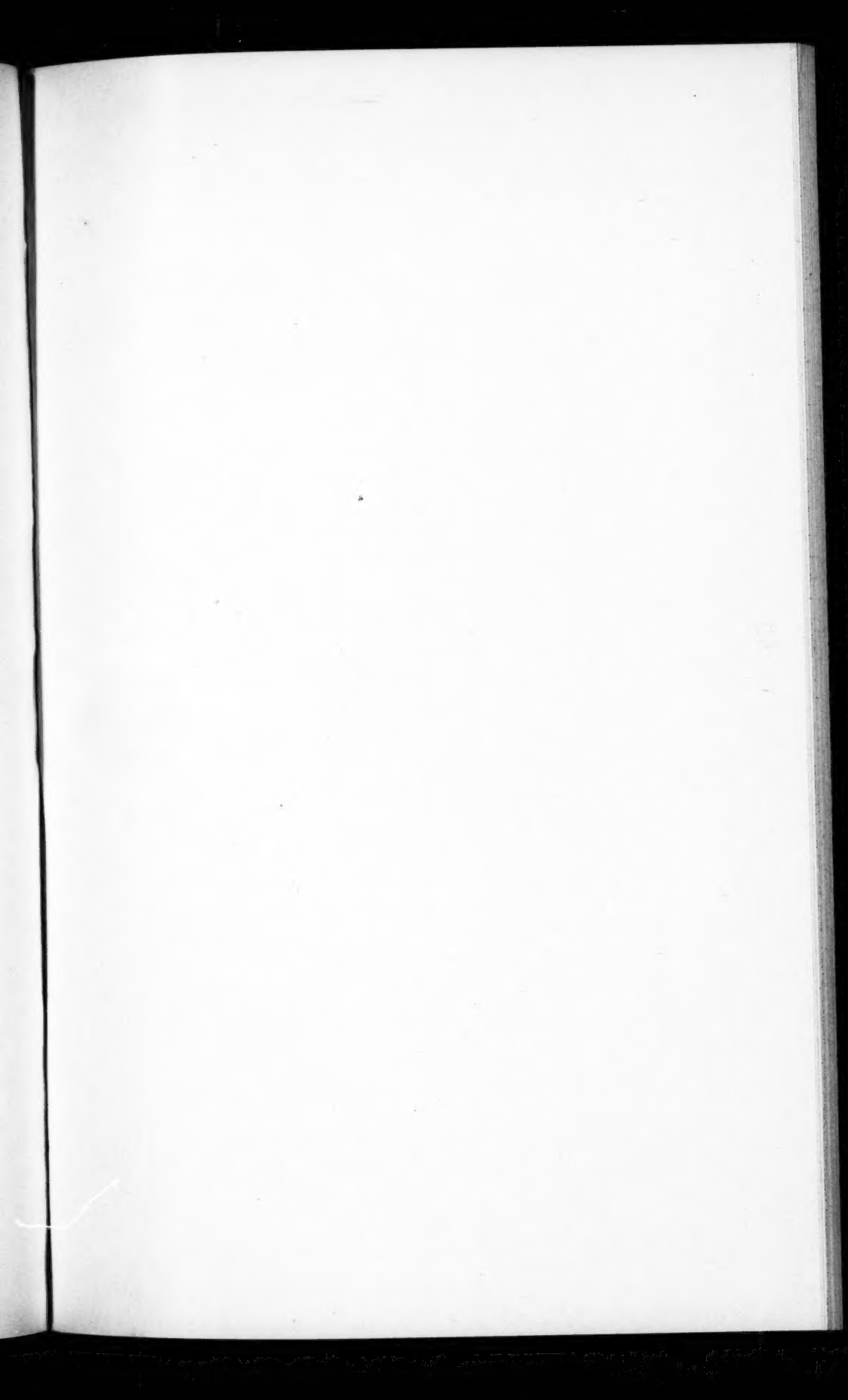
Left, *N.* "Mrs. Edwards Whitaker" ♂, lavender-blue.

Right, *N. ovalifolia* ♀, white, blue-tipped.

Center, *N.* "Mrs. G. H. Pring," albino.

PRING—A NEW HYBRID NYMPHAEA



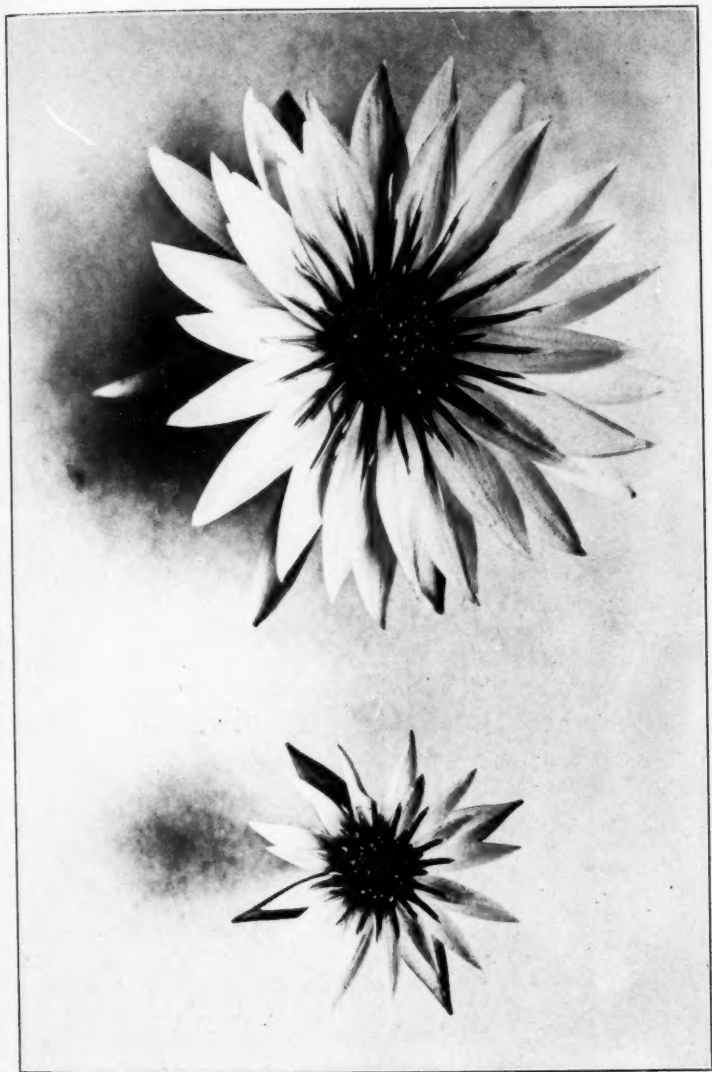


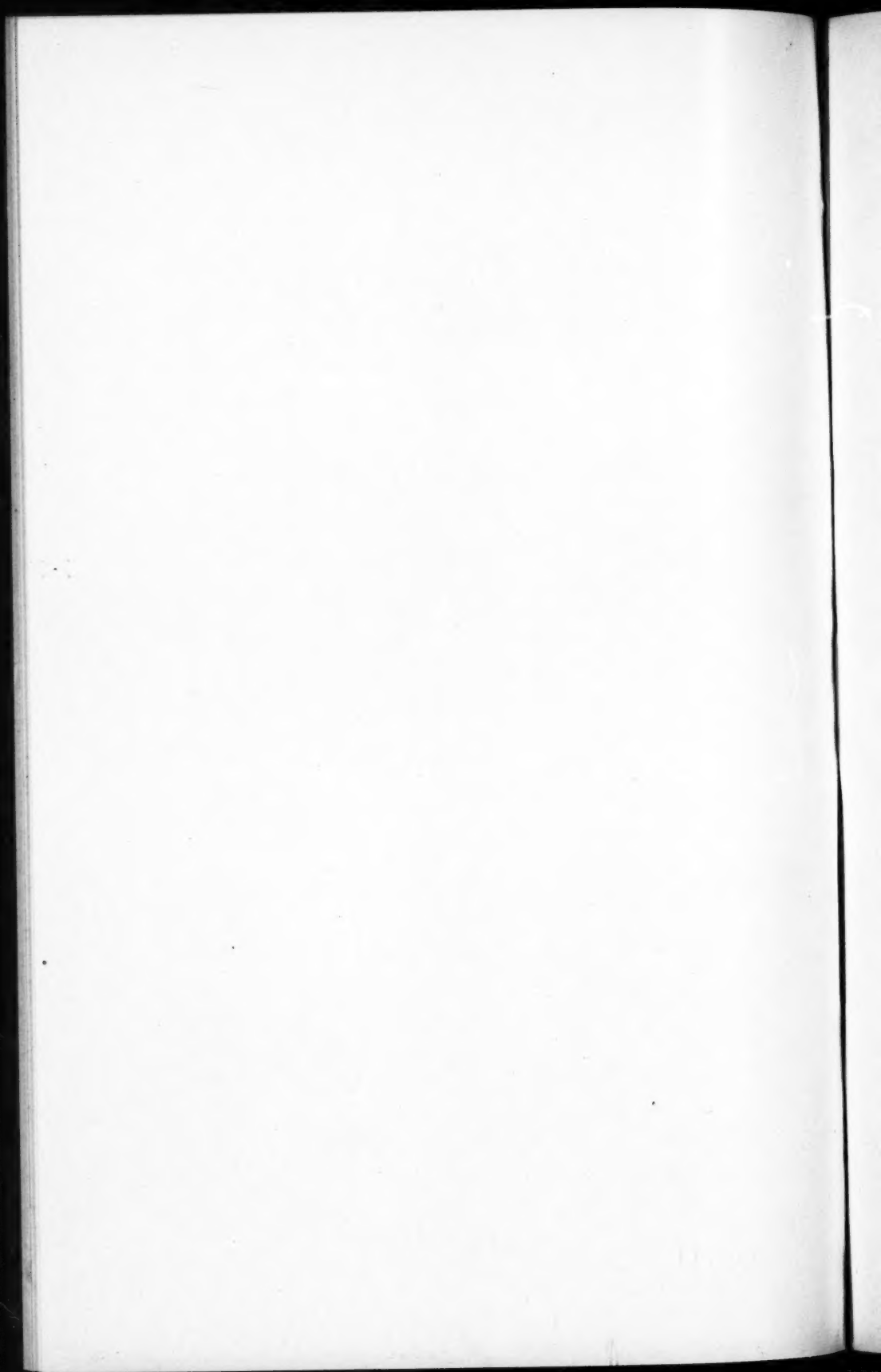
EXPLANATION OF PLATE

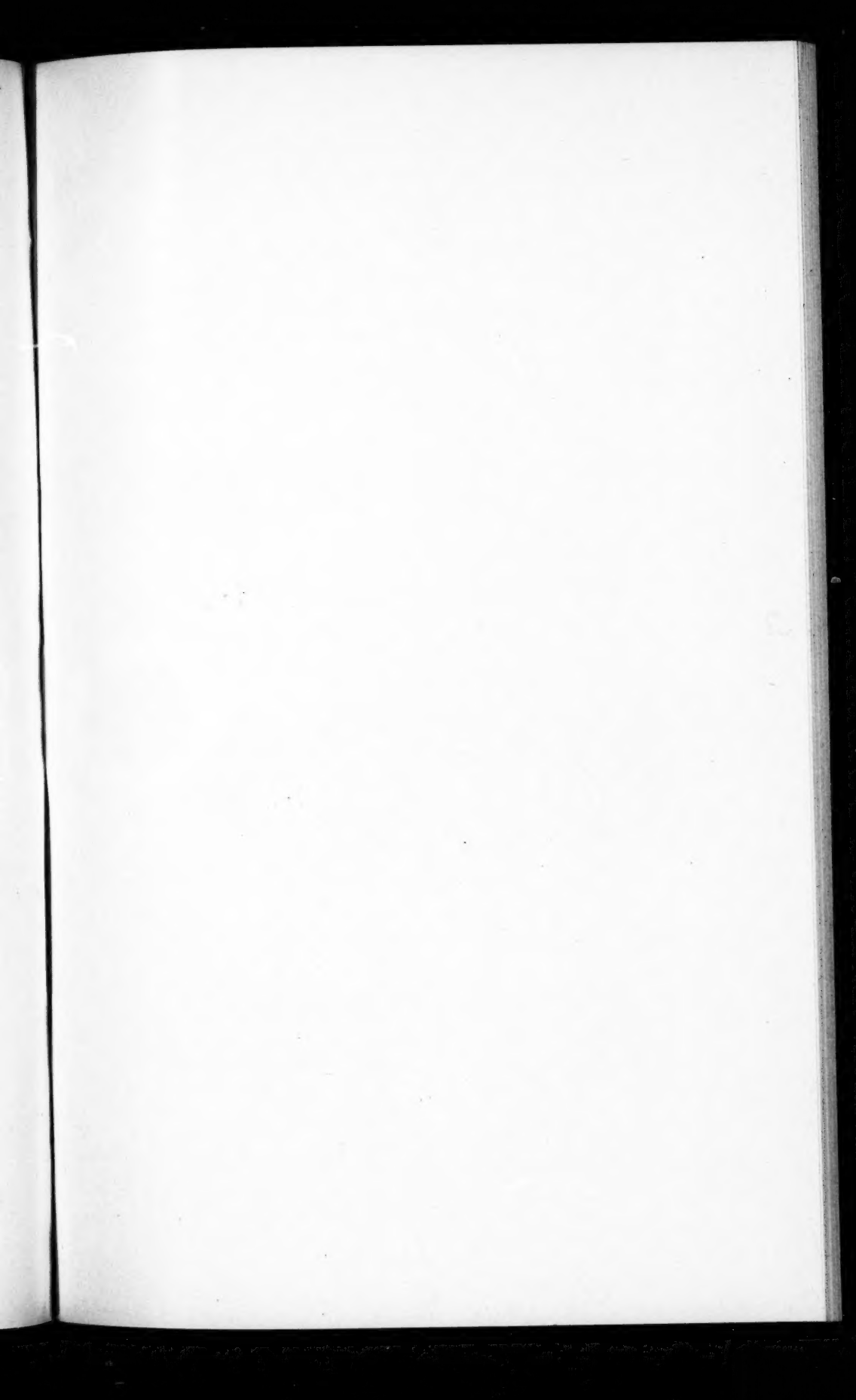
PLATE 21

Showing difference between the white *Nymphaea gracilis*, native of Mexico,
and new white hybrid, N. "Mrs. G. H. Pring."

PRING—A NEW HYBRID NYMPHAEA







EXPLANATION OF PLATE

PLATE 22

Nymphaea "Mrs. G. H. Pring," growing in the ponds of the Missouri Botanical Garden, St. Louis. Photograph taken August 1, 1922.

PRING—A NEW HYBRID NYMPHAEA

